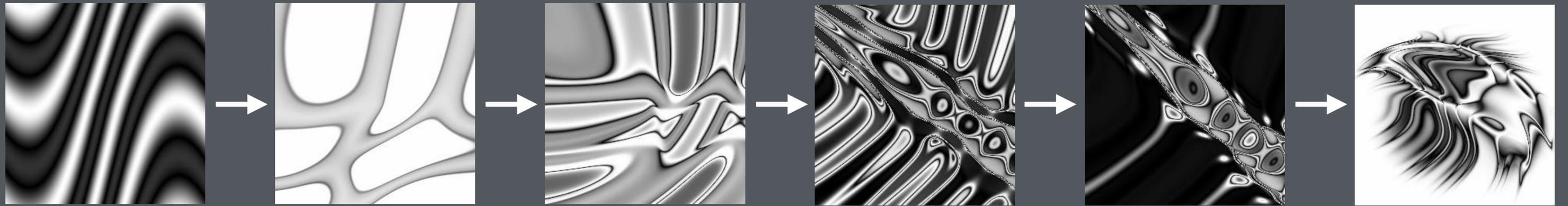


# Cultural Evolution

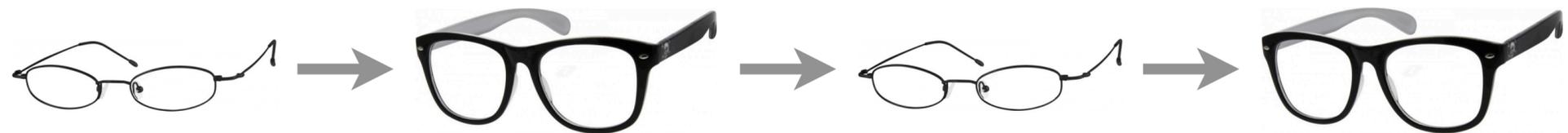
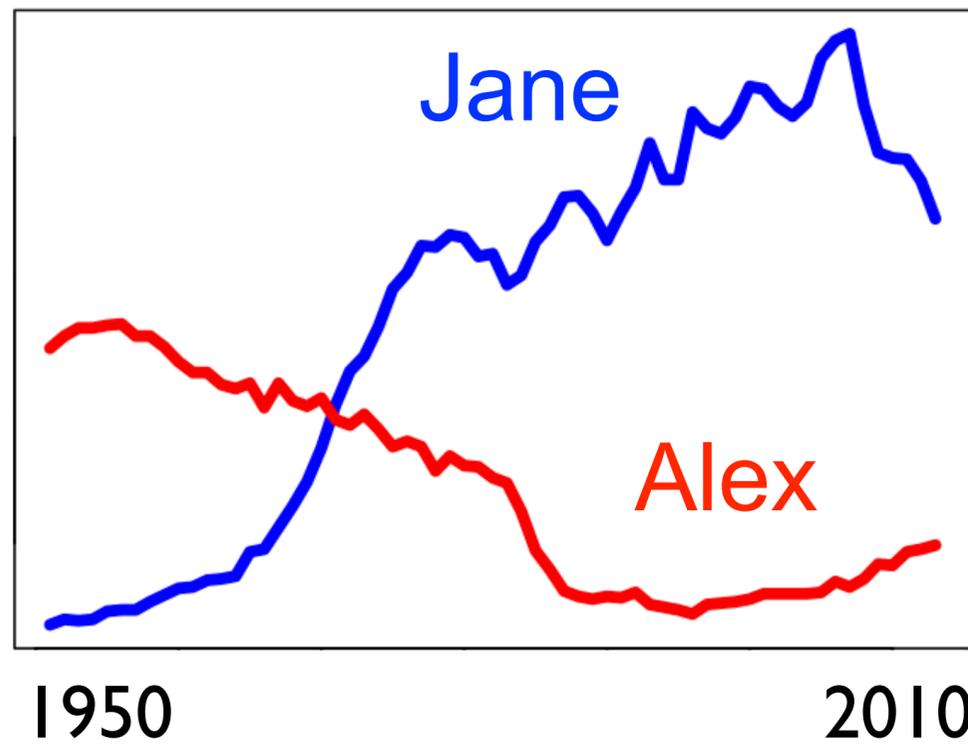
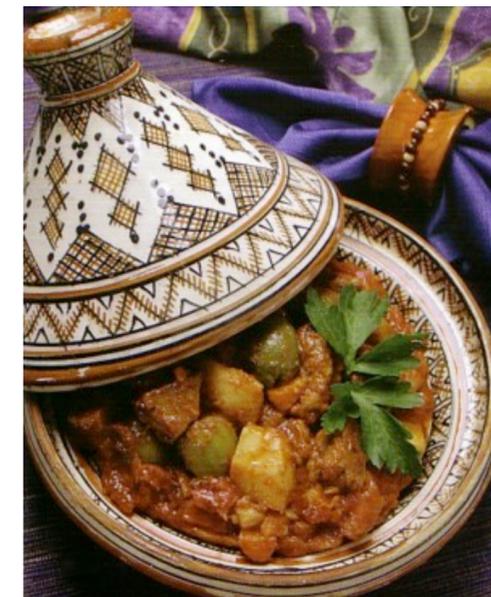


Vanessa Ferdinand

Santa Fe Institute

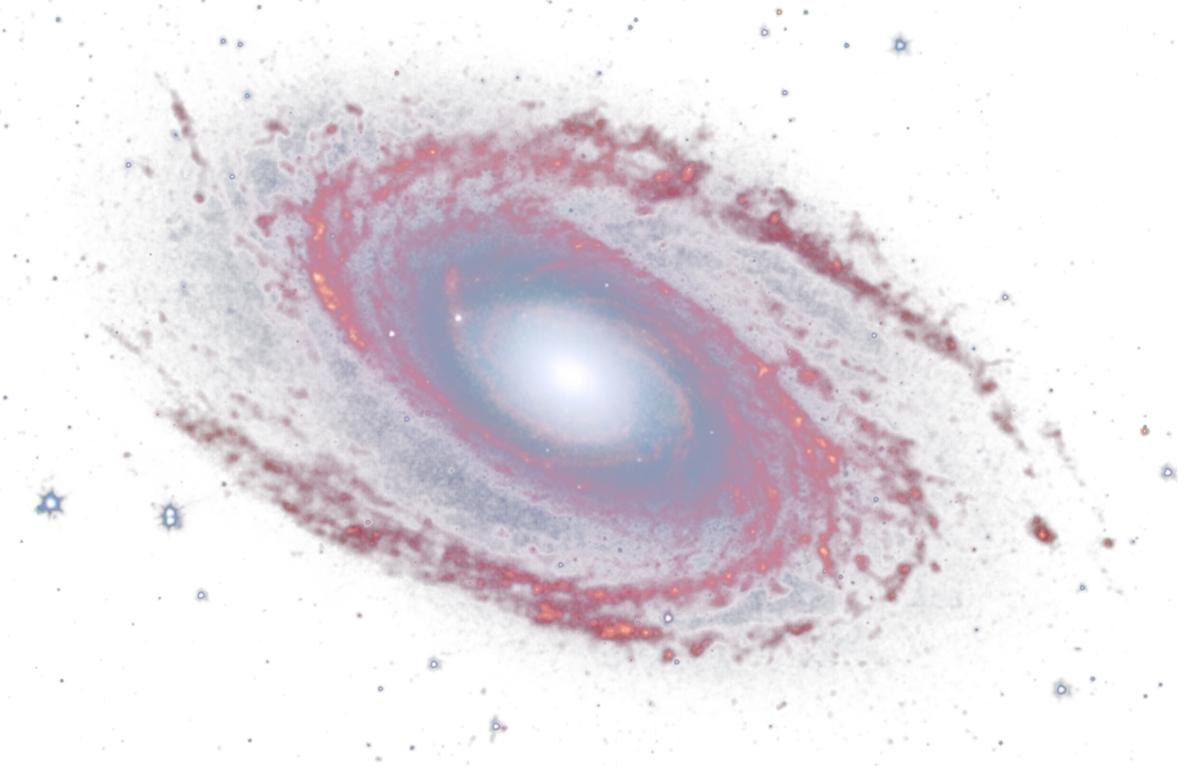


# Culture evolves.



What is evolution?

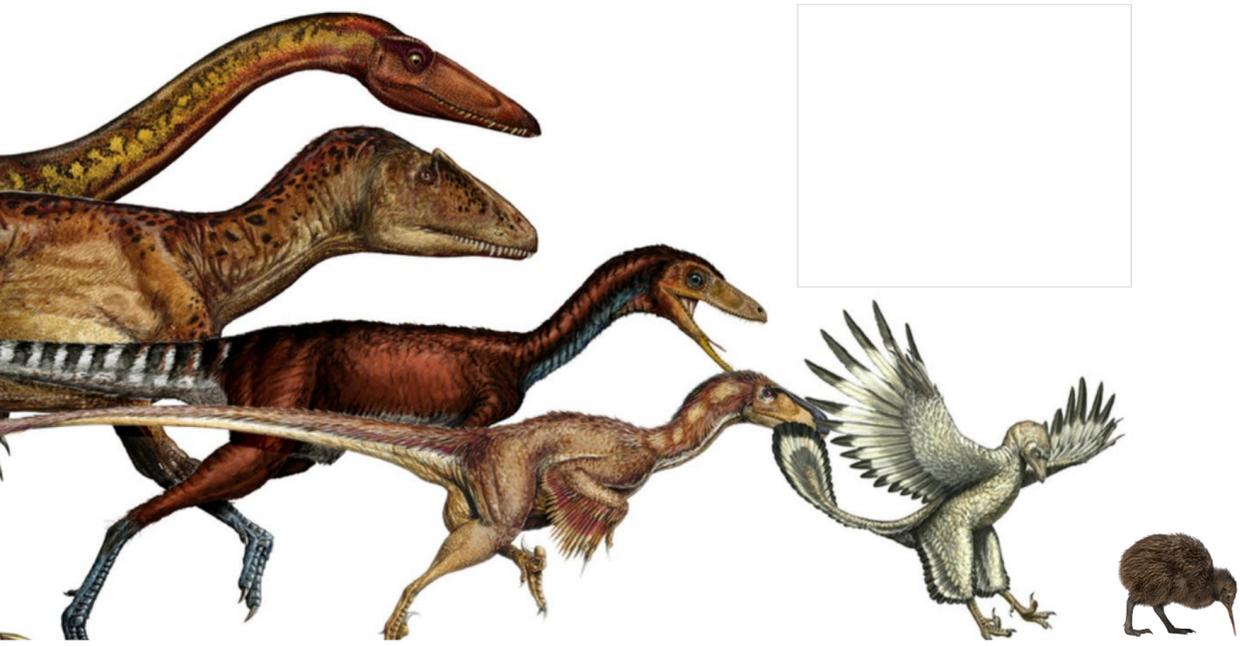
It's change over time.



Galaxies evolve.



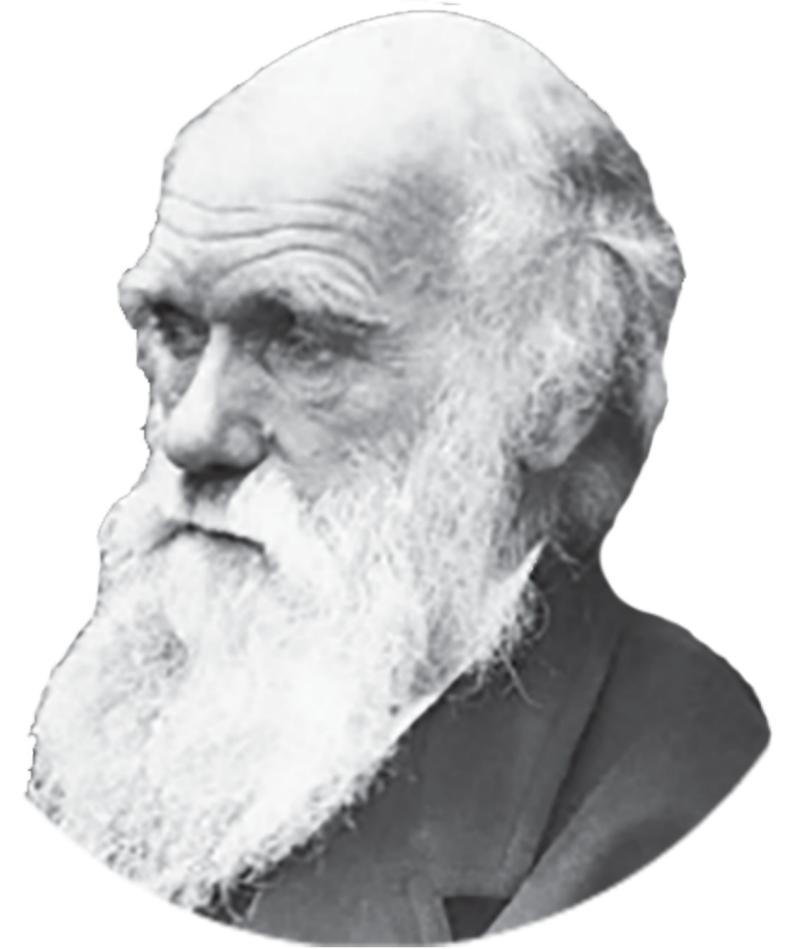
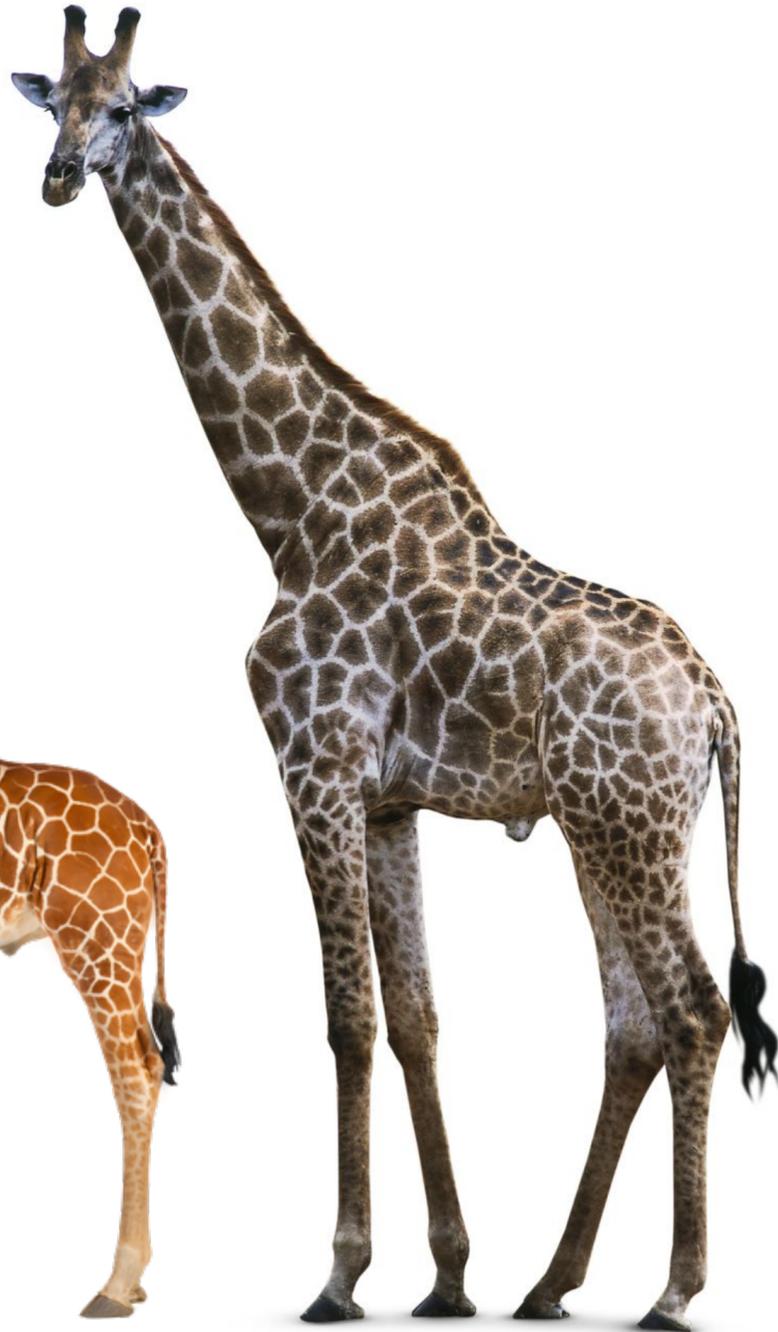
Languages evolve.

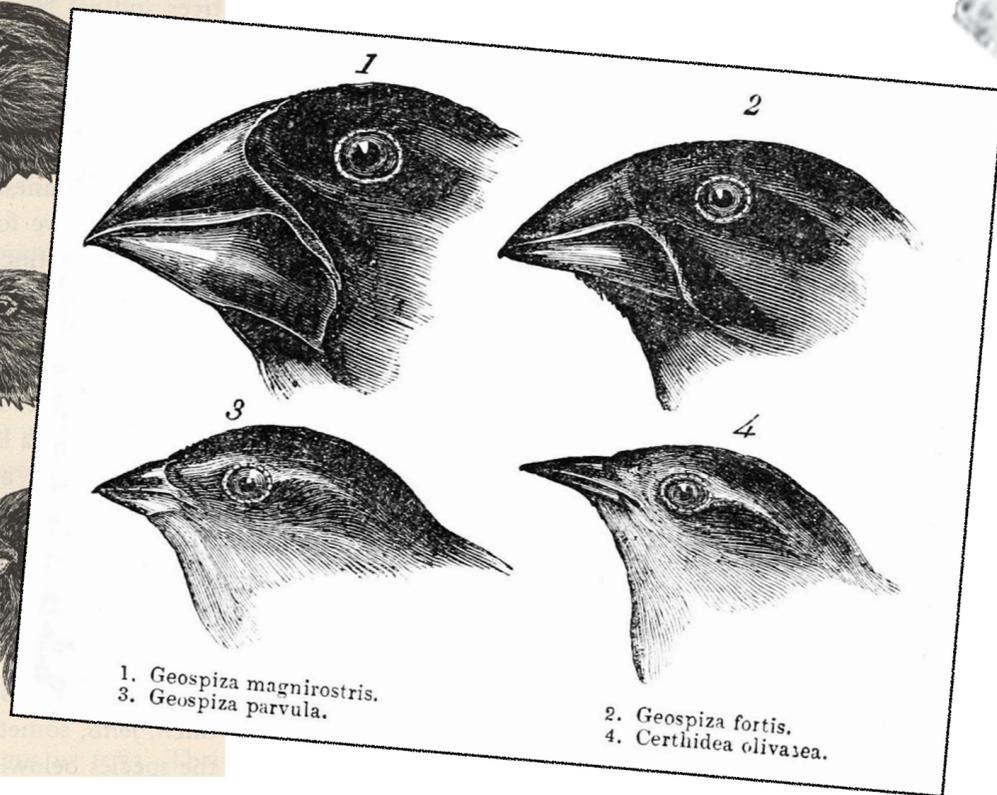
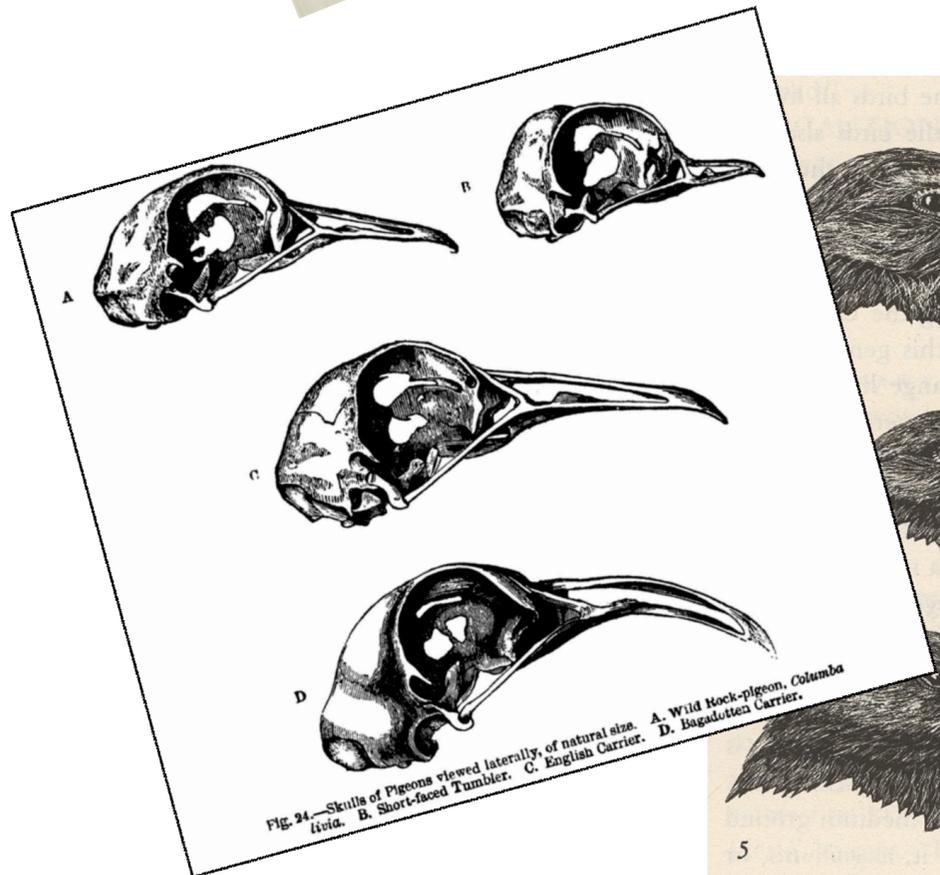
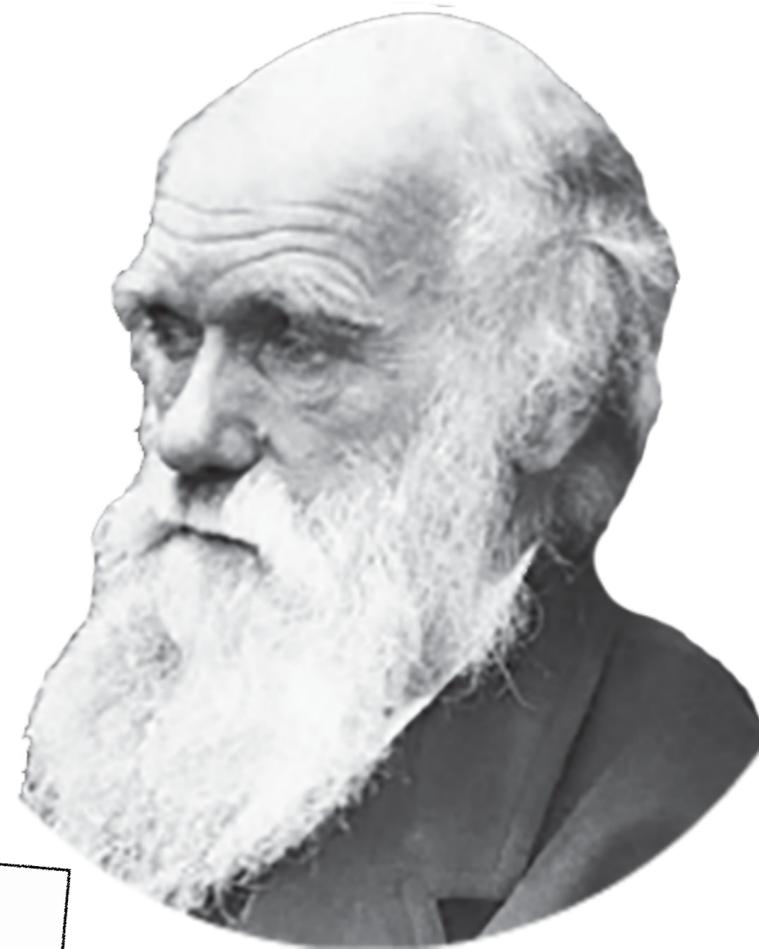


Species evolve.

lame.

# Darwinian evolution

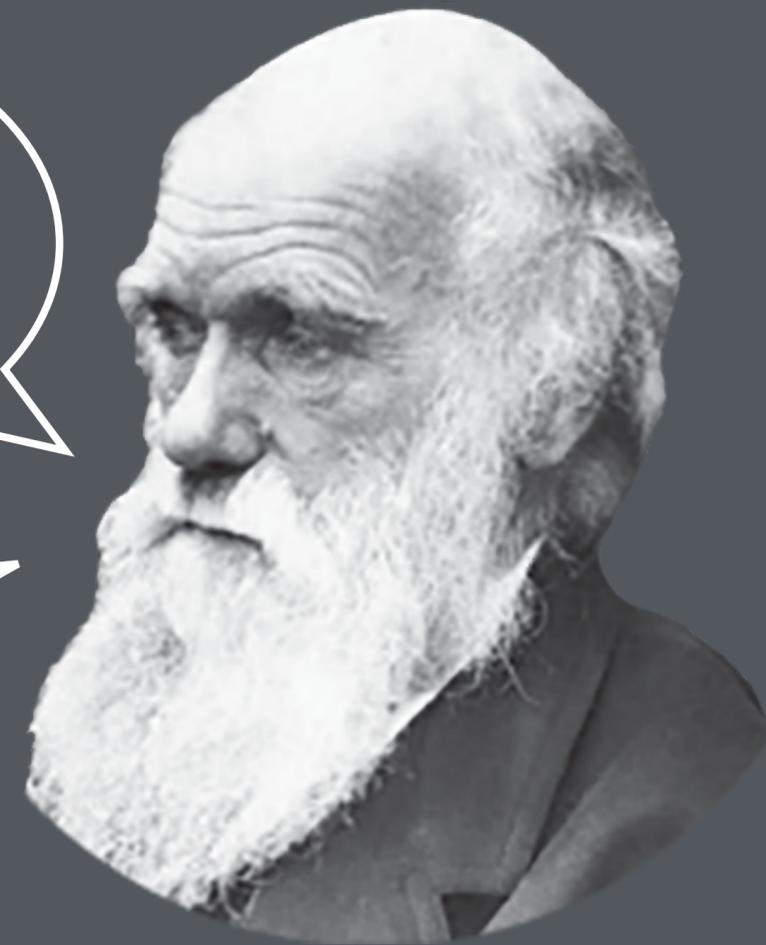




What is the mechanism  
of inheritance?

*Dunno.  
It's 1859!*

*But it's  
somewhere in  
reproduction.*



Answer: It's DNA



What is the mechanism  
of *cultural* inheritance?

*Dunno.  
It's 2018!*

*But it's  
somewhere in  
cognition.*

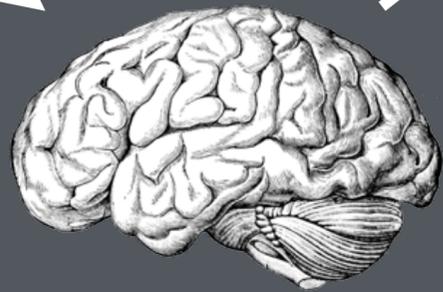


CULTURAL  
EVOLUTION  
SOCIETY

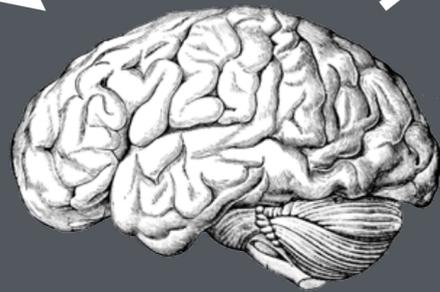
Answer:



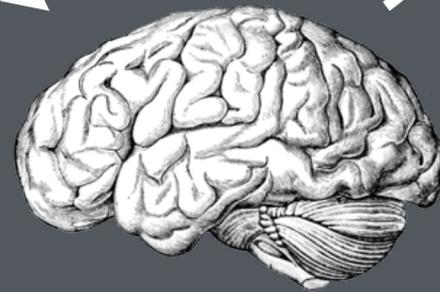
**artifacts**



**artifacts**



**artifacts**



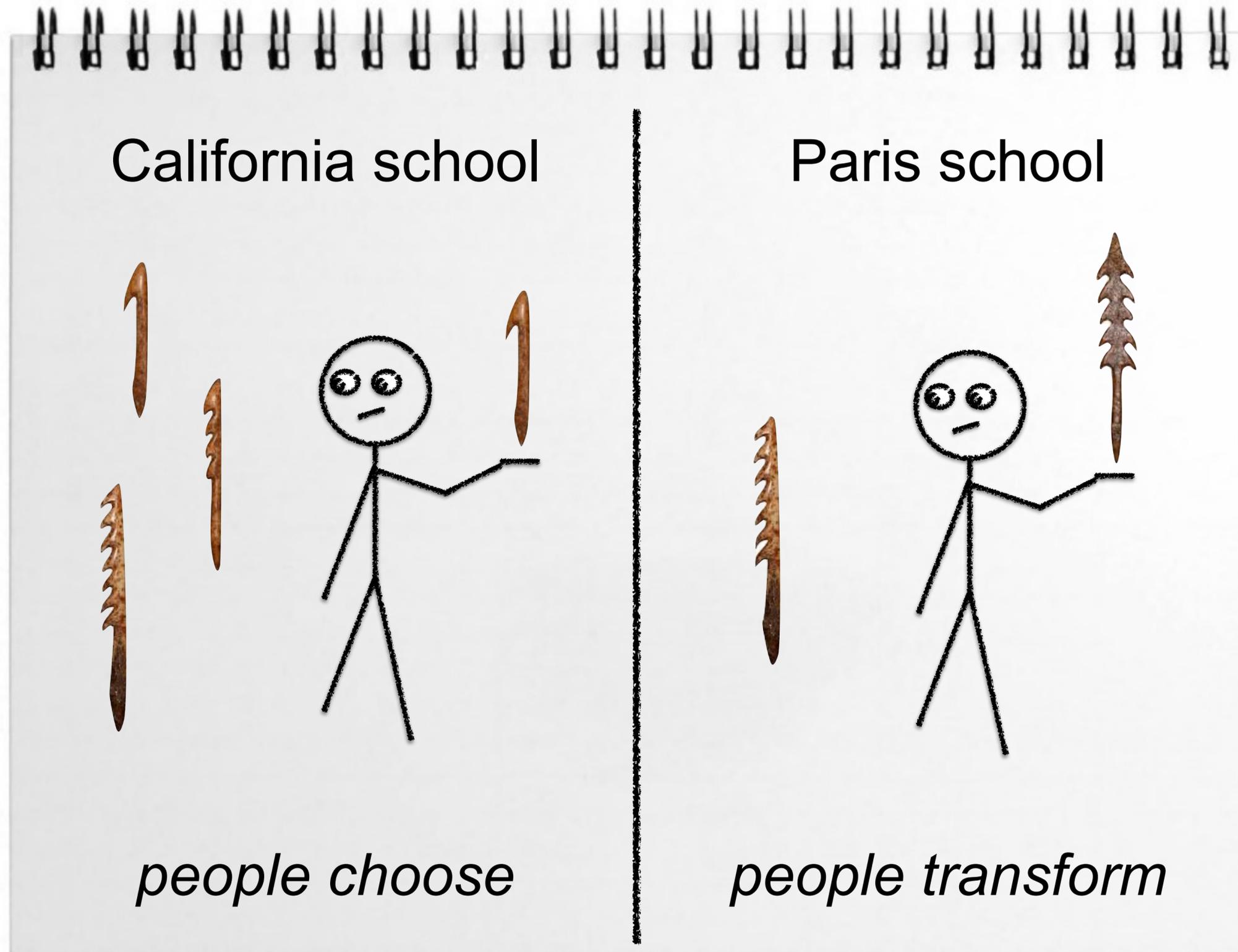
**artifacts**



**cul·ture** /'kəlCHər/

Anything that requires a  
cognitive system to replicate

# What drives change in culture?



California school



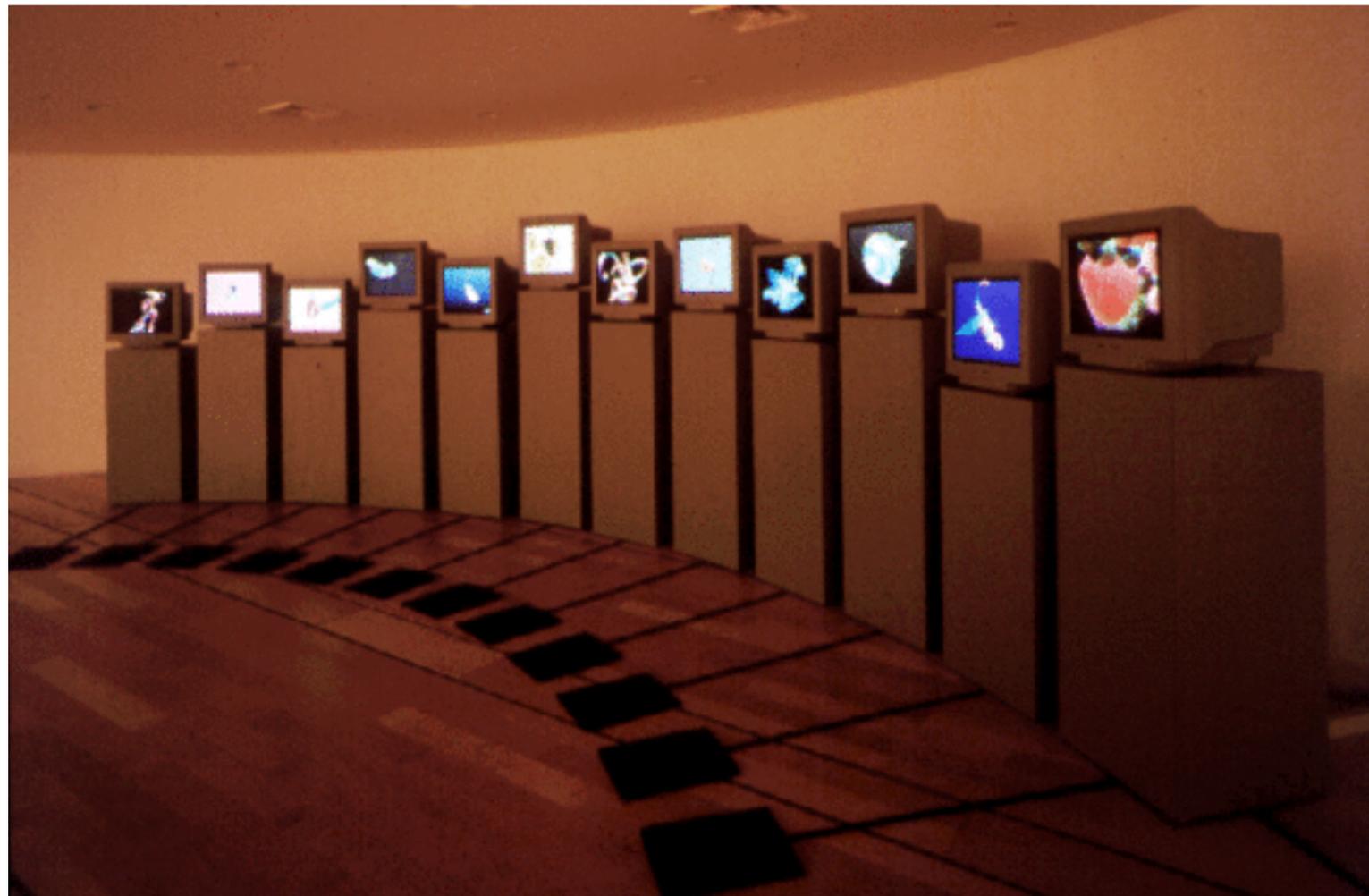
*people choose*

Paris school



*people transform*

# Evolutionary art



Genetic Images Interactive Exhibit

Karl Sims

1990s



# picbreeder.org

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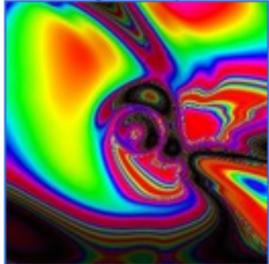
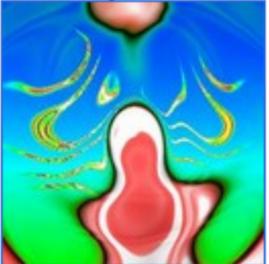
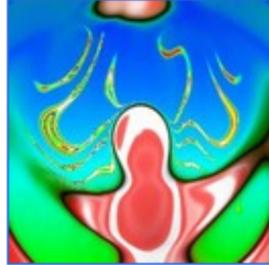
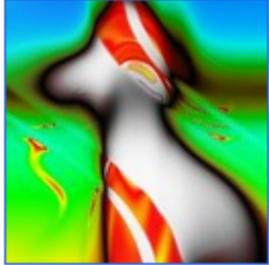
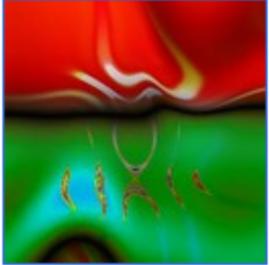
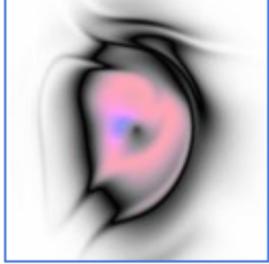
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6. [ken](#)
7. [adeleir](#)
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 <p>Evolve DNA ★★★★★</p> <p><a href="#">head Face</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">head Face Hat</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">Bat ghost</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">dolphin Animal color</a> By Crul</p>
 <p>Evolve DNA ★★★★★</p> <p><a href="#">Nose Face</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">Candy gummy</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">leather mask Warrior</a> By Crul</p>	 <p>Evolve DNA ★★★★★</p> <p><a href="#">horse leather Animal</a> By Crul</p>
			

# Ken Stanley

2007



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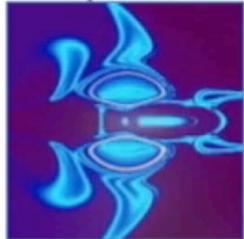
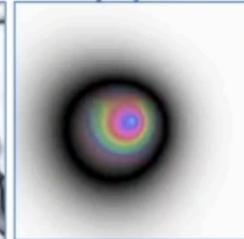
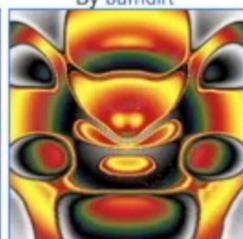
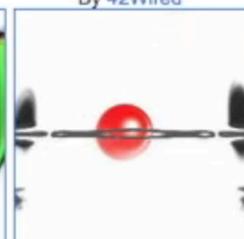
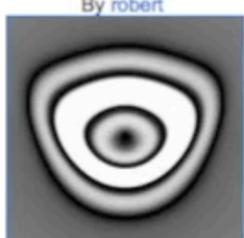
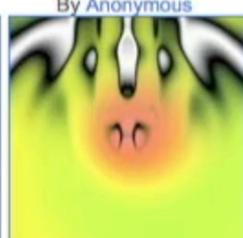
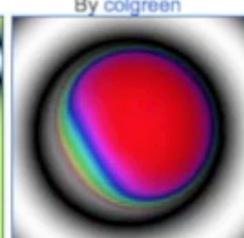
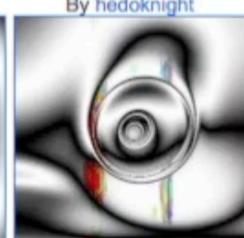
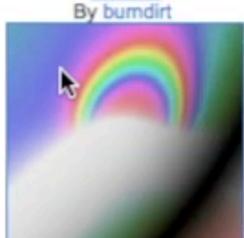
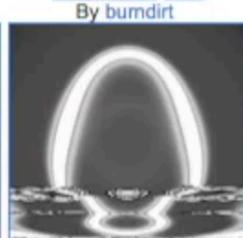
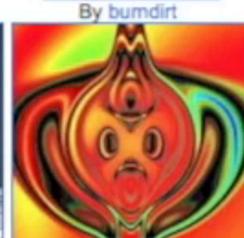
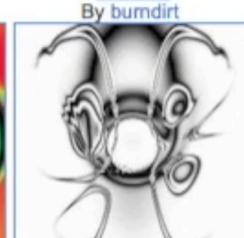
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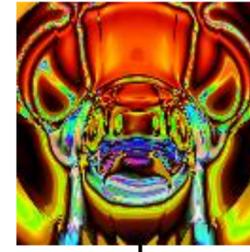
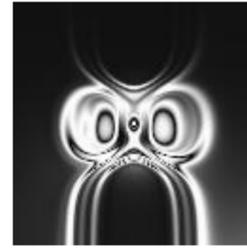
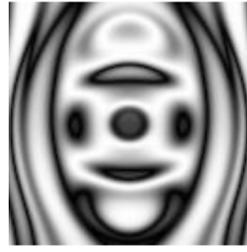
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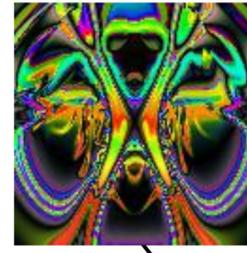
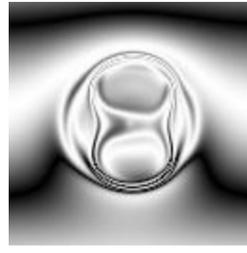
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<p><a href="#">egg4child 8</a> By robert</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">bull flare horns</a> By Anonymous</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">Marble</a> By colgreen</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">lumpy melty</a> By hedoknight</p>  <p>Evolve DNA ★★★★★</p>
<p><a href="#">rainbow</a> By burndirt</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">cool pattern arch</a> By burndirt</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">Peter Pumpkinhead</a> By burndirt</p>  <p>Evolve DNA ★★★★★</p>	<p><a href="#">creature</a> By burndirt</p>  <p>Evolve DNA ★★★★★</p>

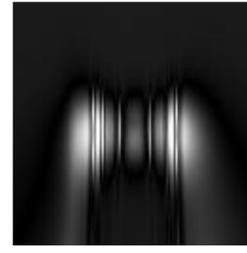
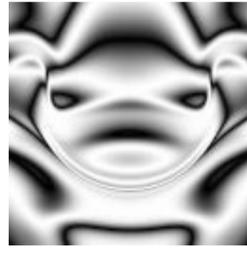
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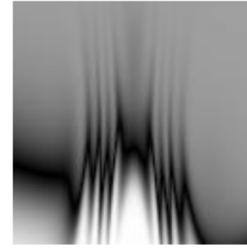
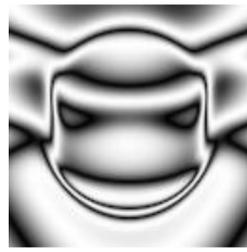
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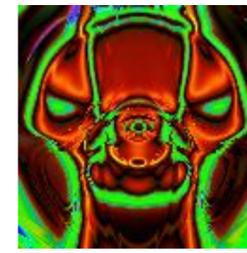
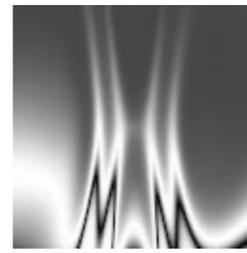
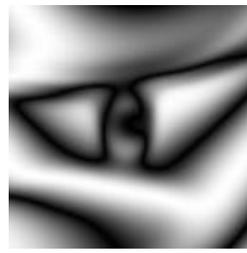
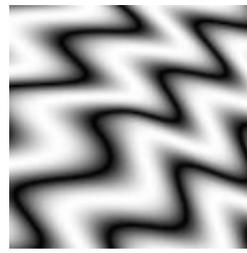
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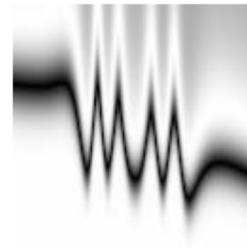
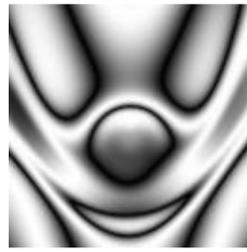
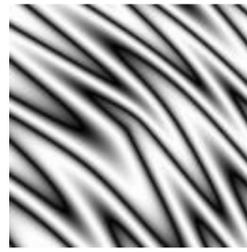
generation 3



generation 2



generation 1



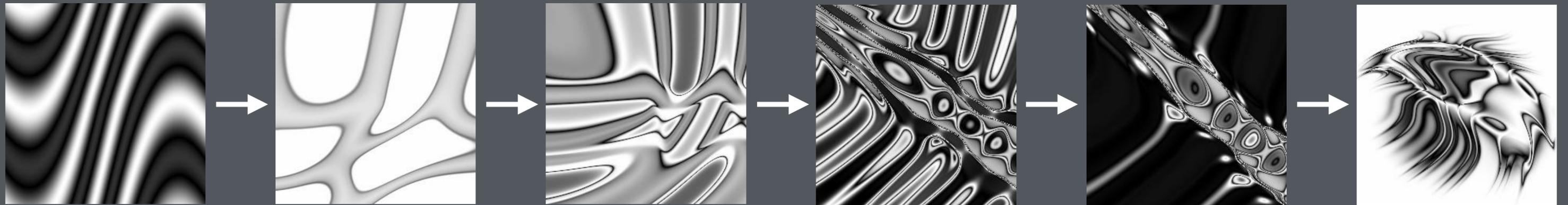
lineage A

lineage B

lineage C

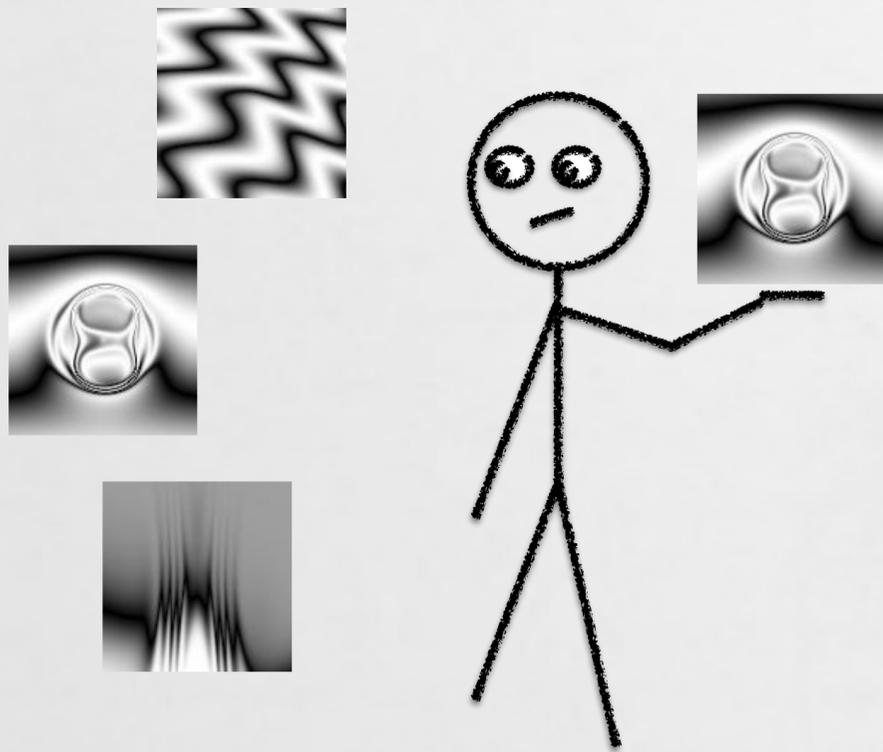
lineage C

Images get more complex over time.

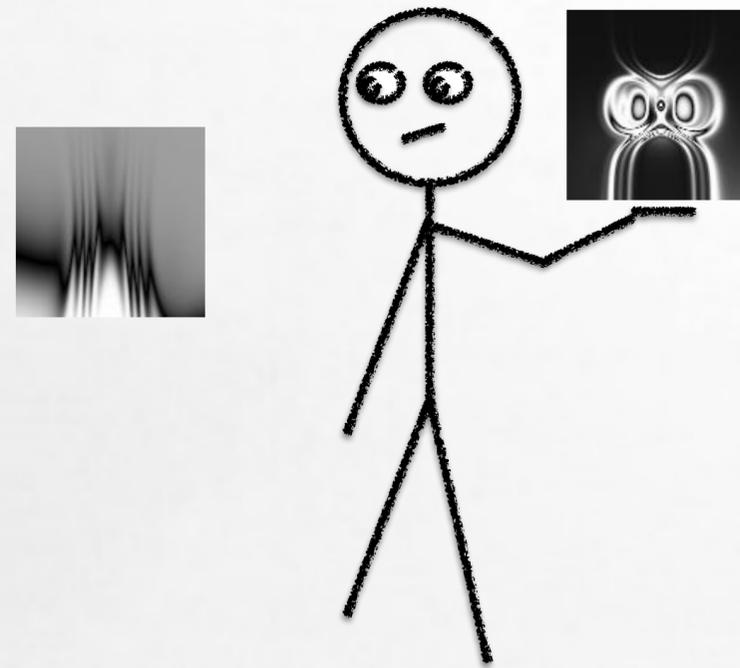


Why?

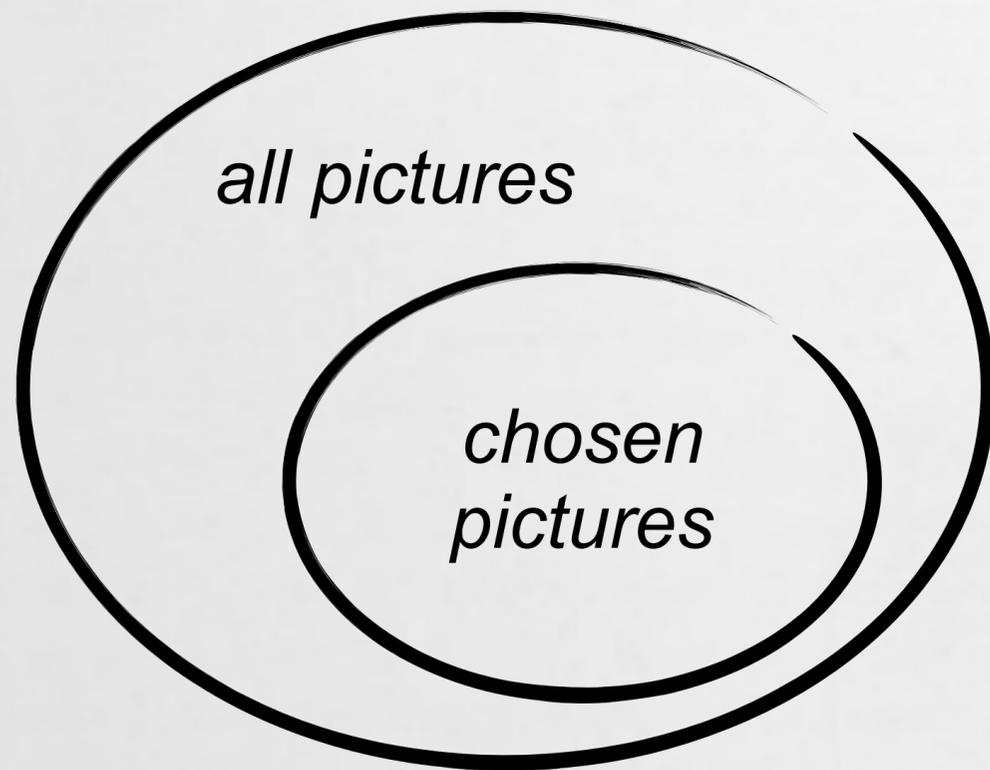
choose



transform

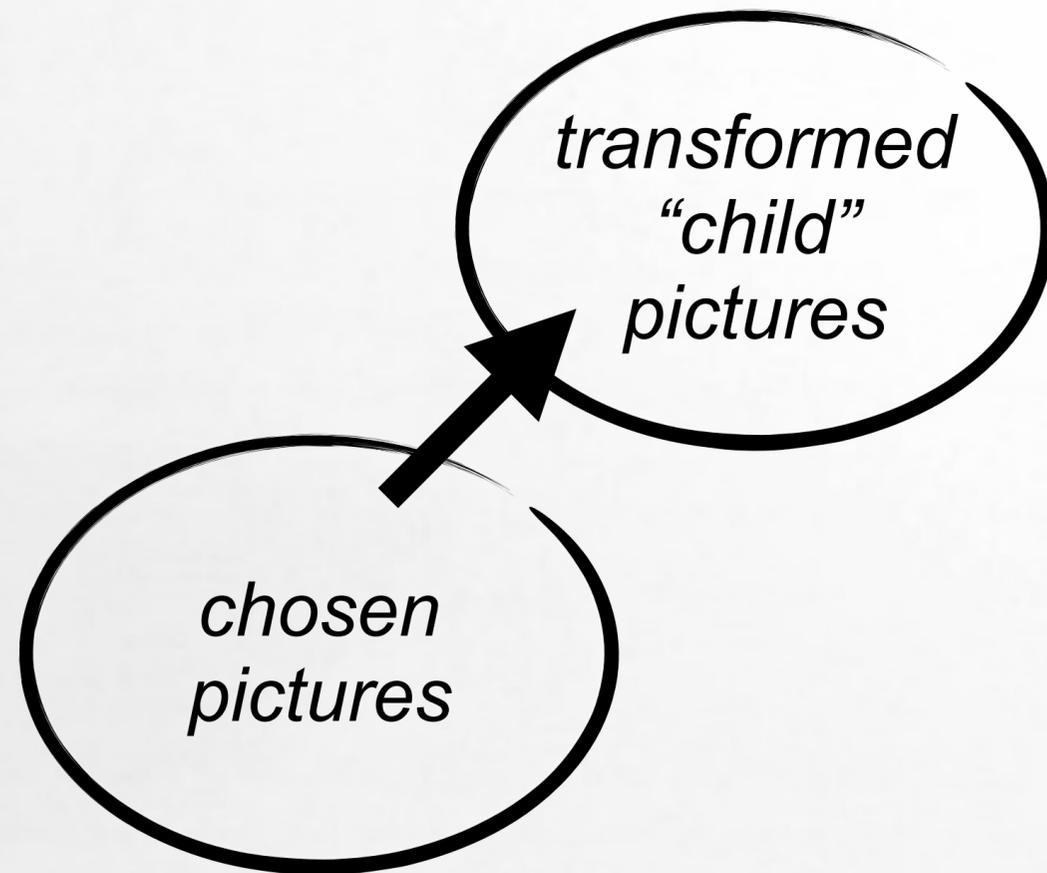


choose



*Is the complexity of the chosen images higher?*

transform



*Is the complexity of the child images higher?*

# Measuring image complexity



Pieter Bruegel, 1559



Mark Rothko, 1970

# Measuring image complexity



*There's a woman in the lower left, wearing a grey dress with red sleeves who is strangling a demon and above her is a man who...*



*A black rectangle is above a grey rectangle.*

# Measuring image complexity

## Description length method:

*It takes more words to describe something complex and less words to describe something simple.*



左下方有一位女士，身穿灰色衣服 穿著紅色袖子的人正在扼殺  
惡魔在她之上是一個男人



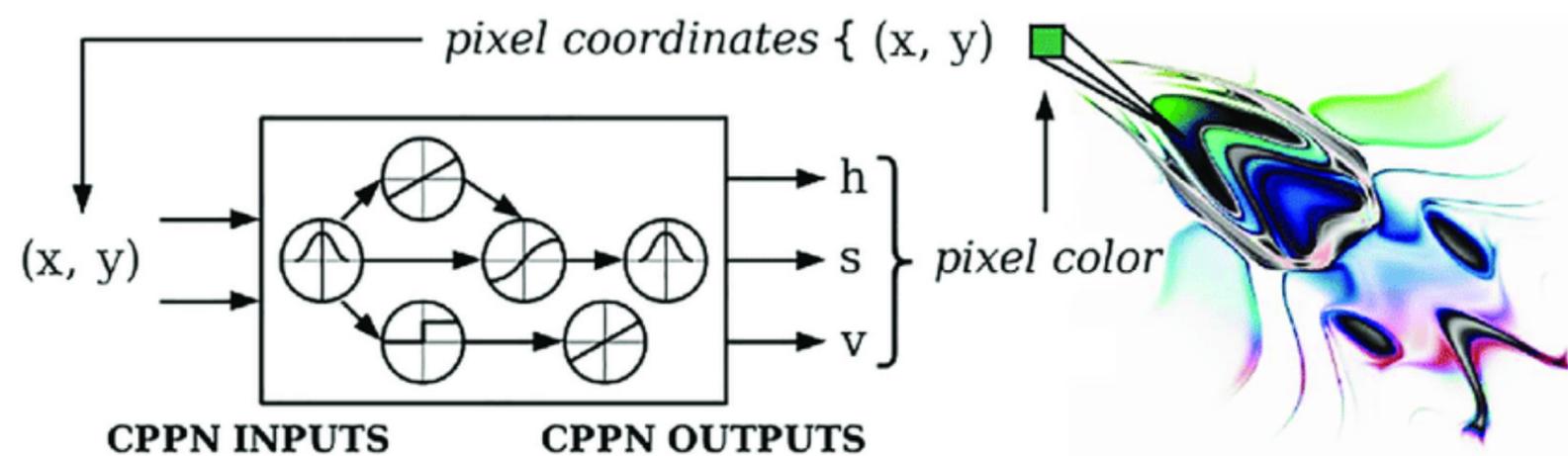
一個黑色的矩形在上面灰色的矩形。

*...but exact length differences are relative to the encoding system*

# Measuring image complexity

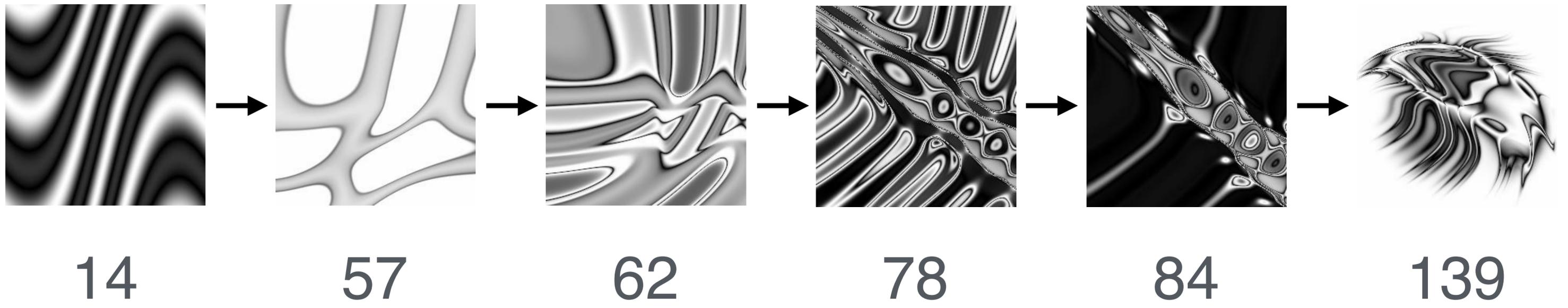
Description length method:

*picbreeder's native encoding scheme for images (a CPPN)*



Program length =  
our complexity measure

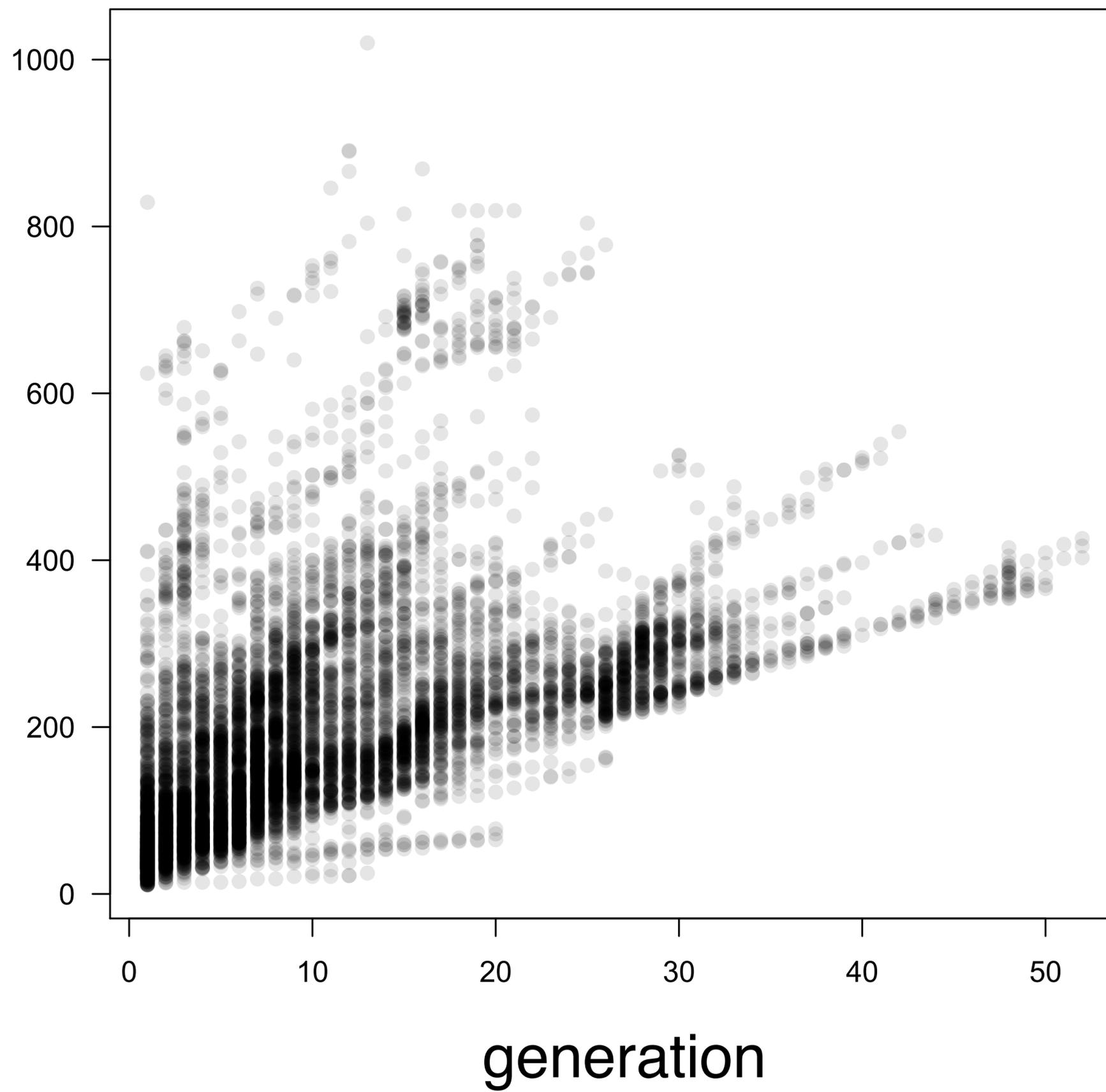
# Measuring image complexity



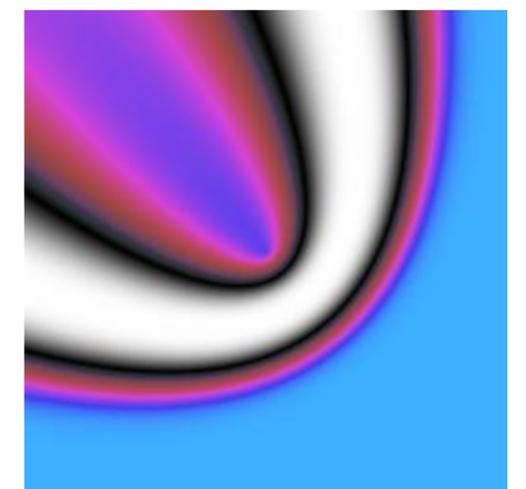
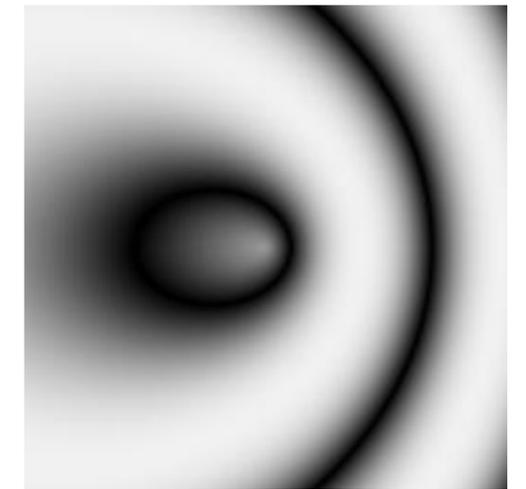
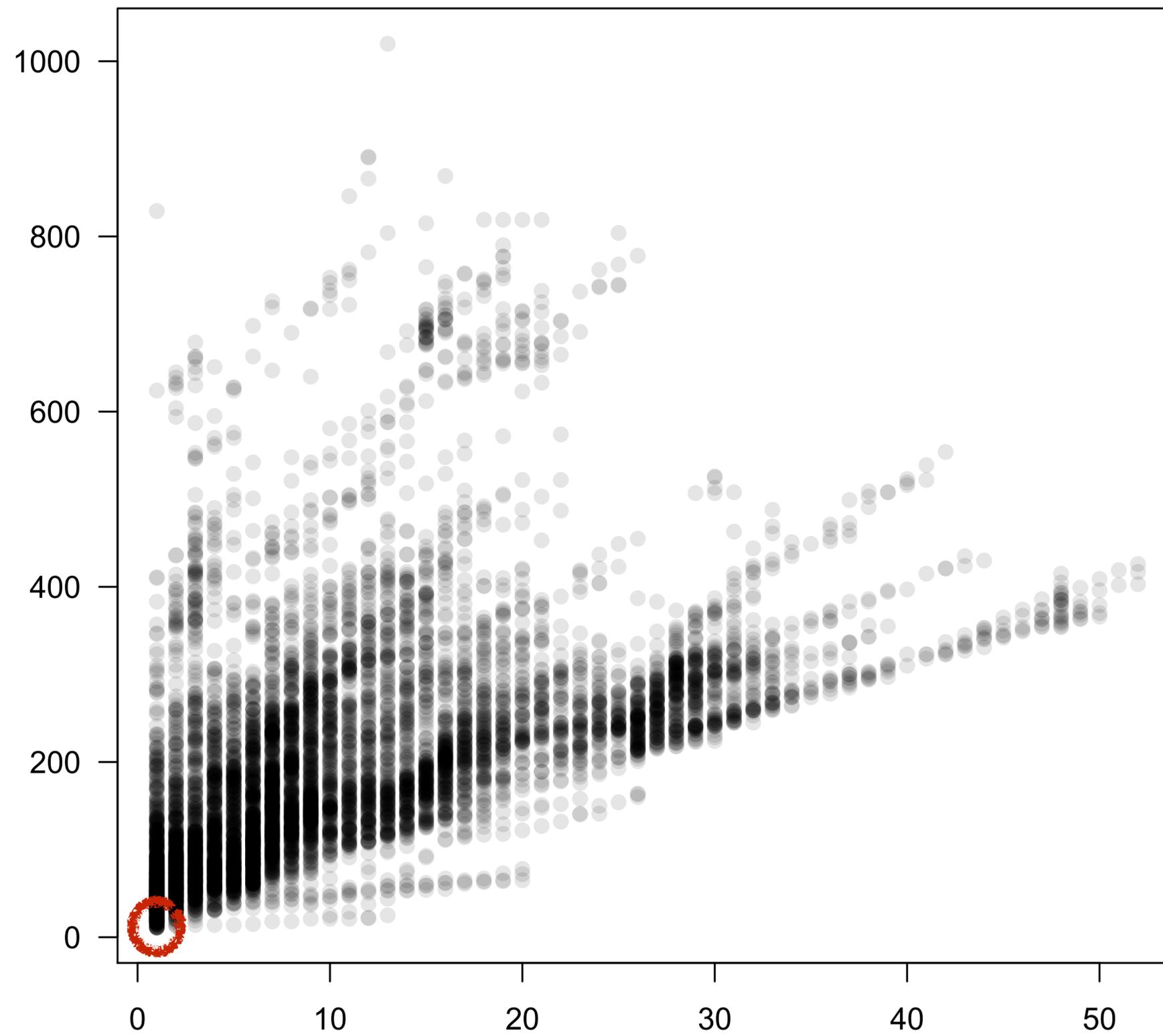
Picbreeder image program length examples

(# nodes + # edges)

complexity

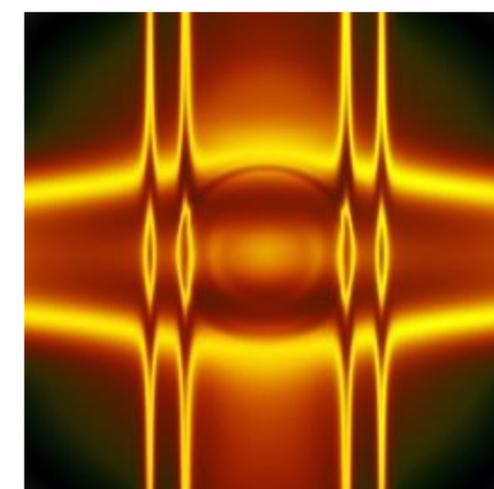
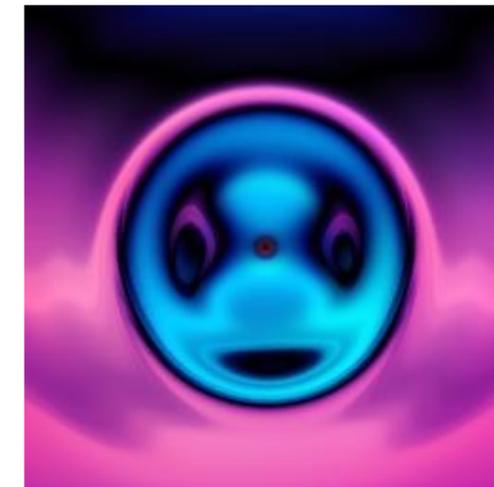
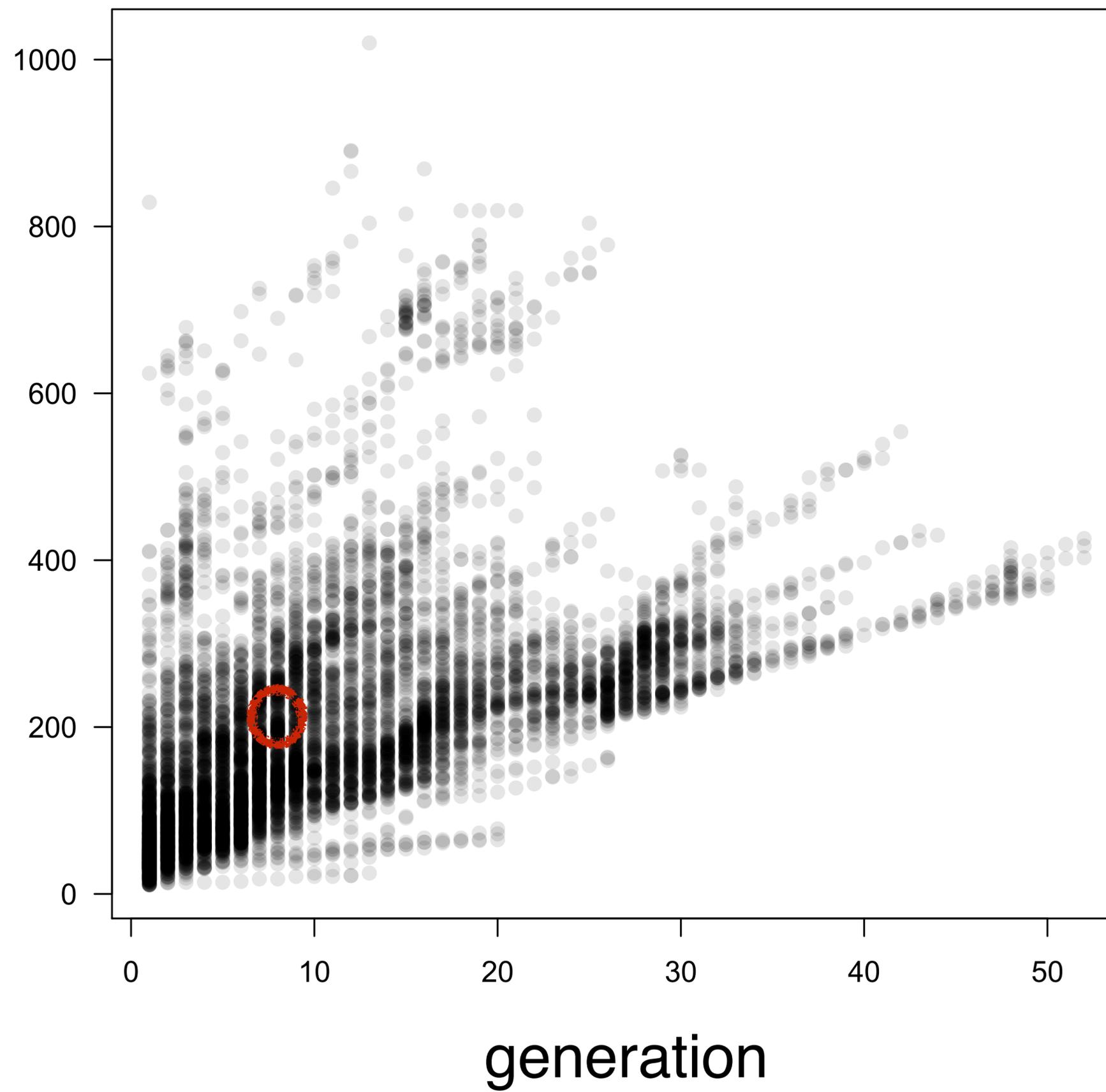


complexity

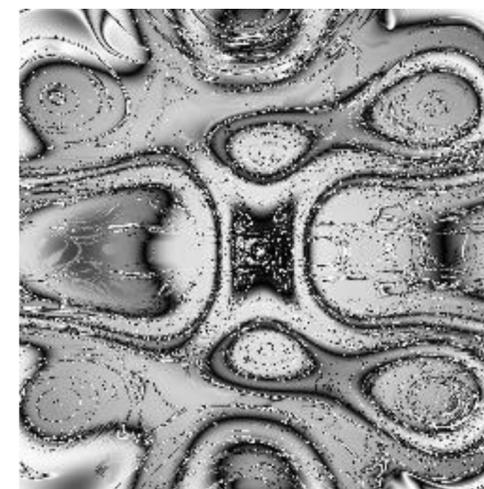
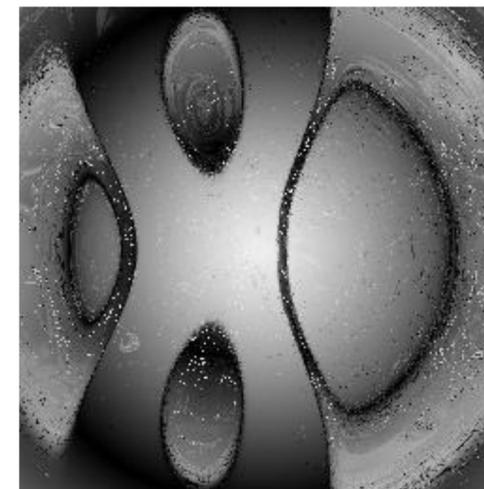
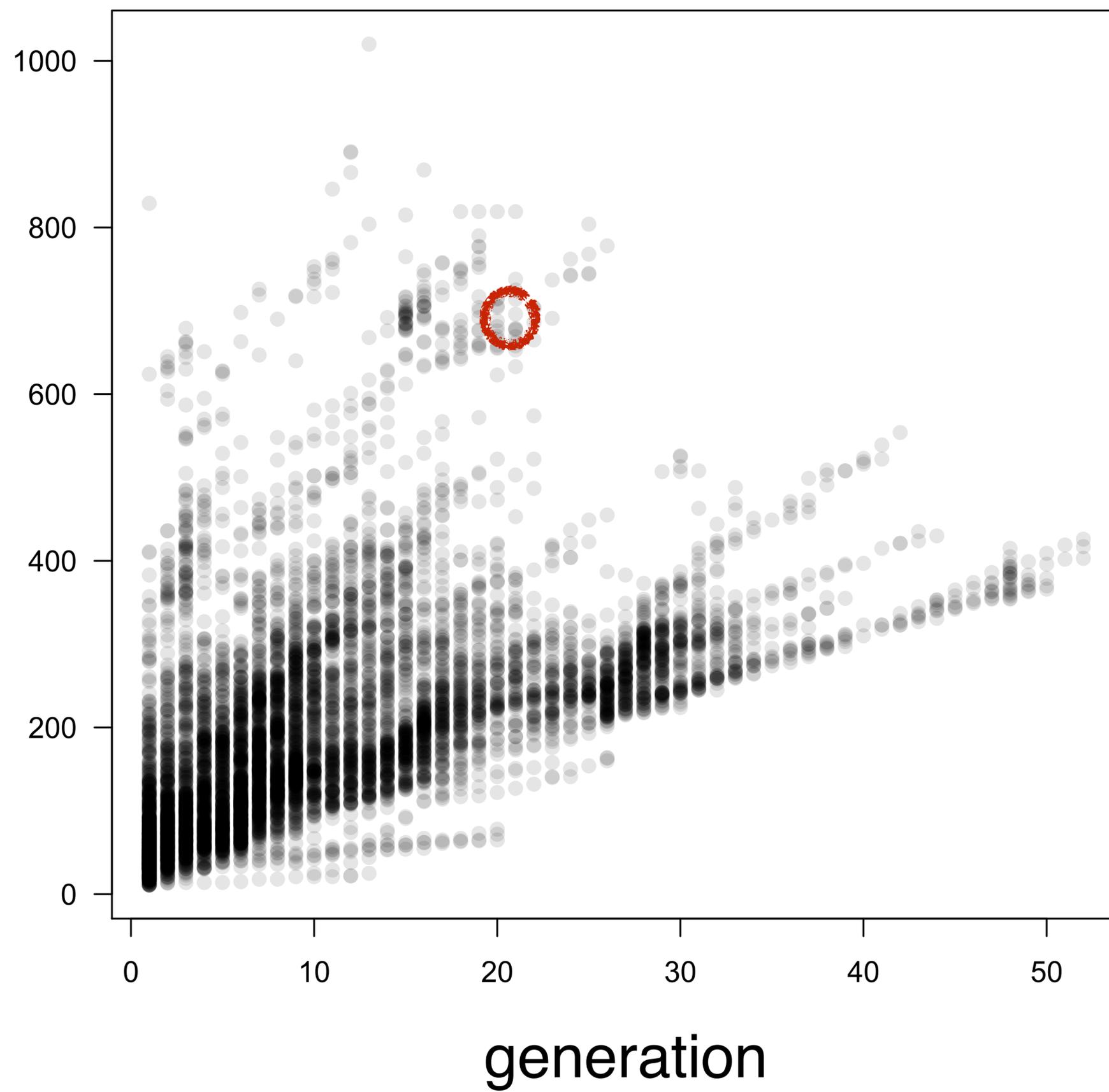


generation

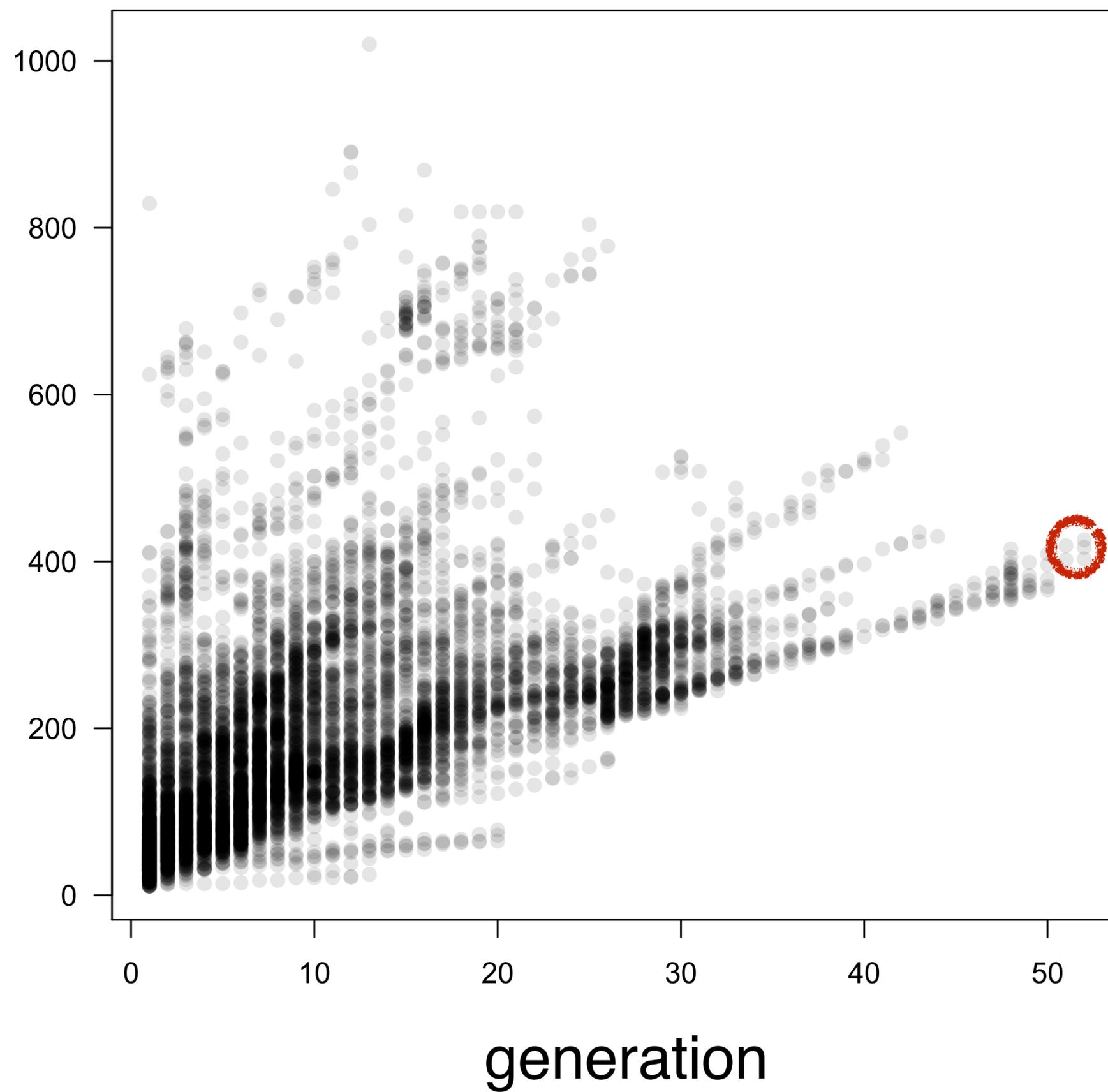
complexity



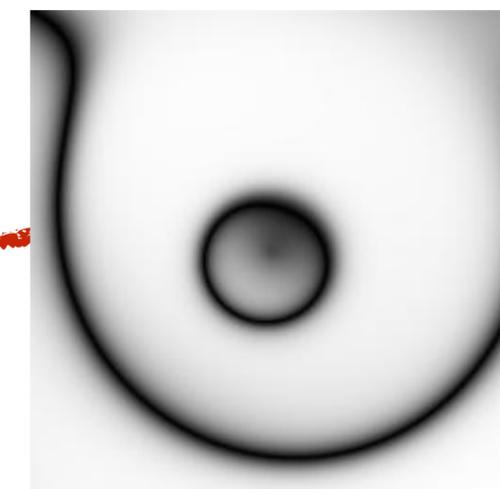
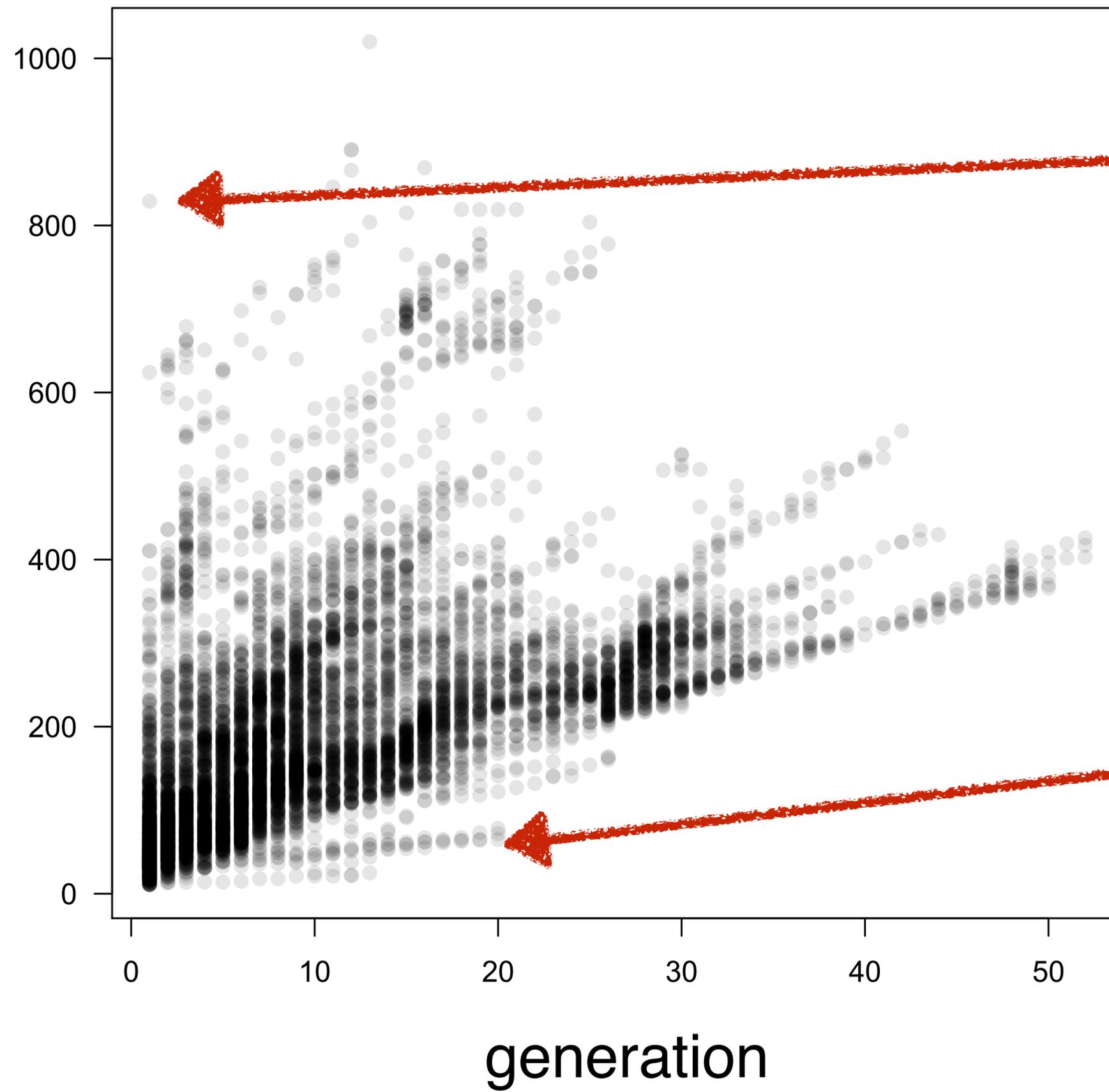
complexity



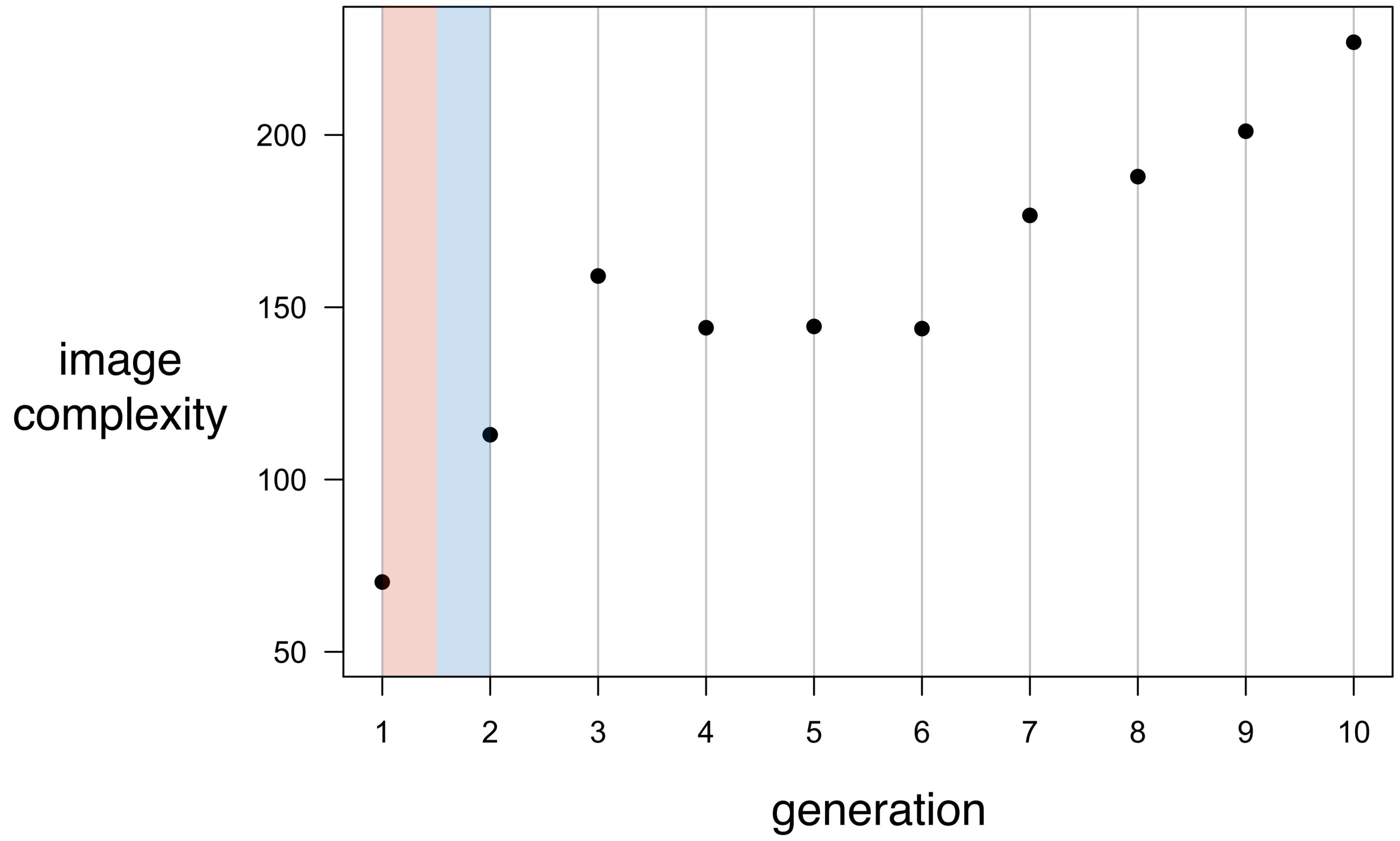
complexity



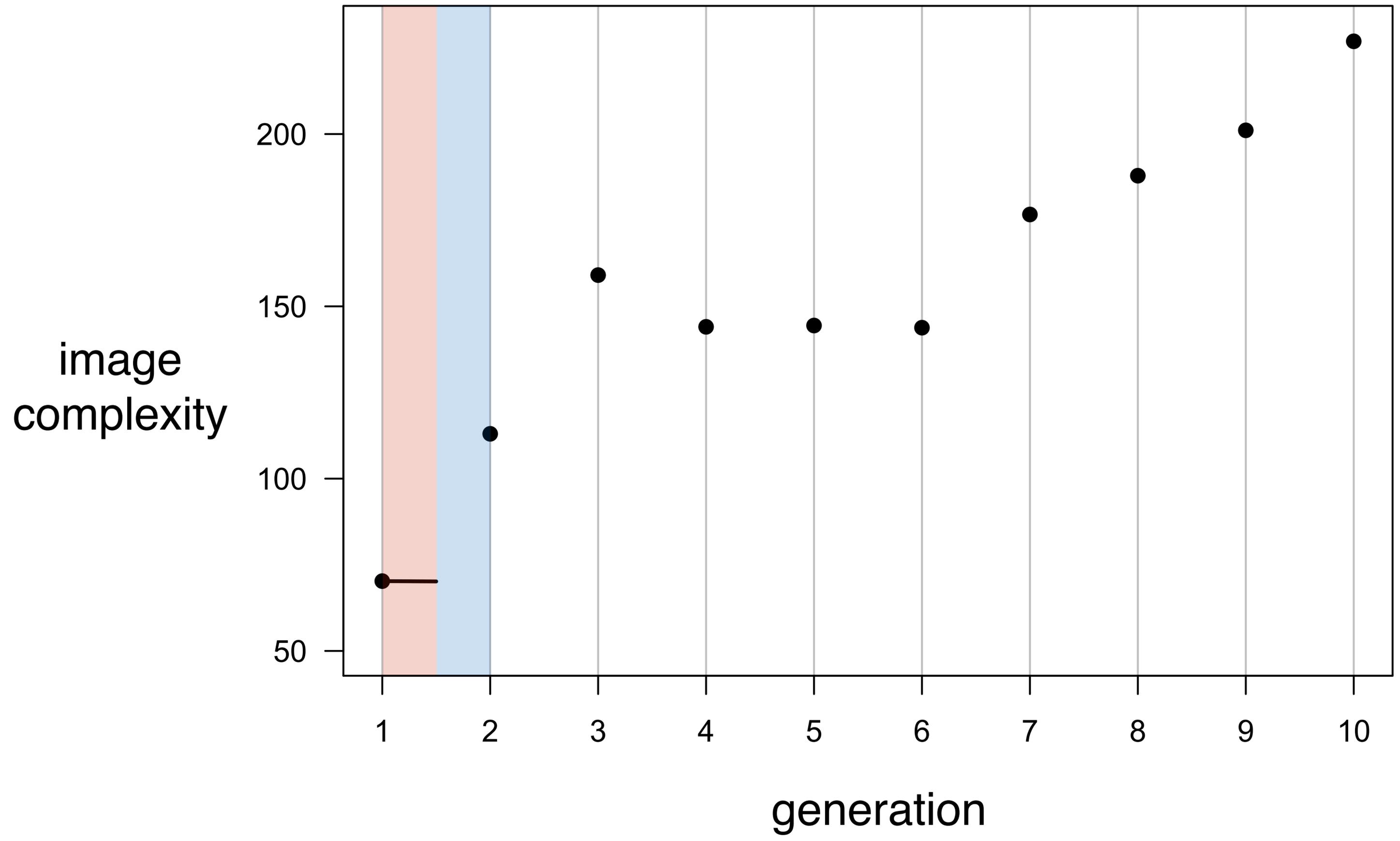
complexity



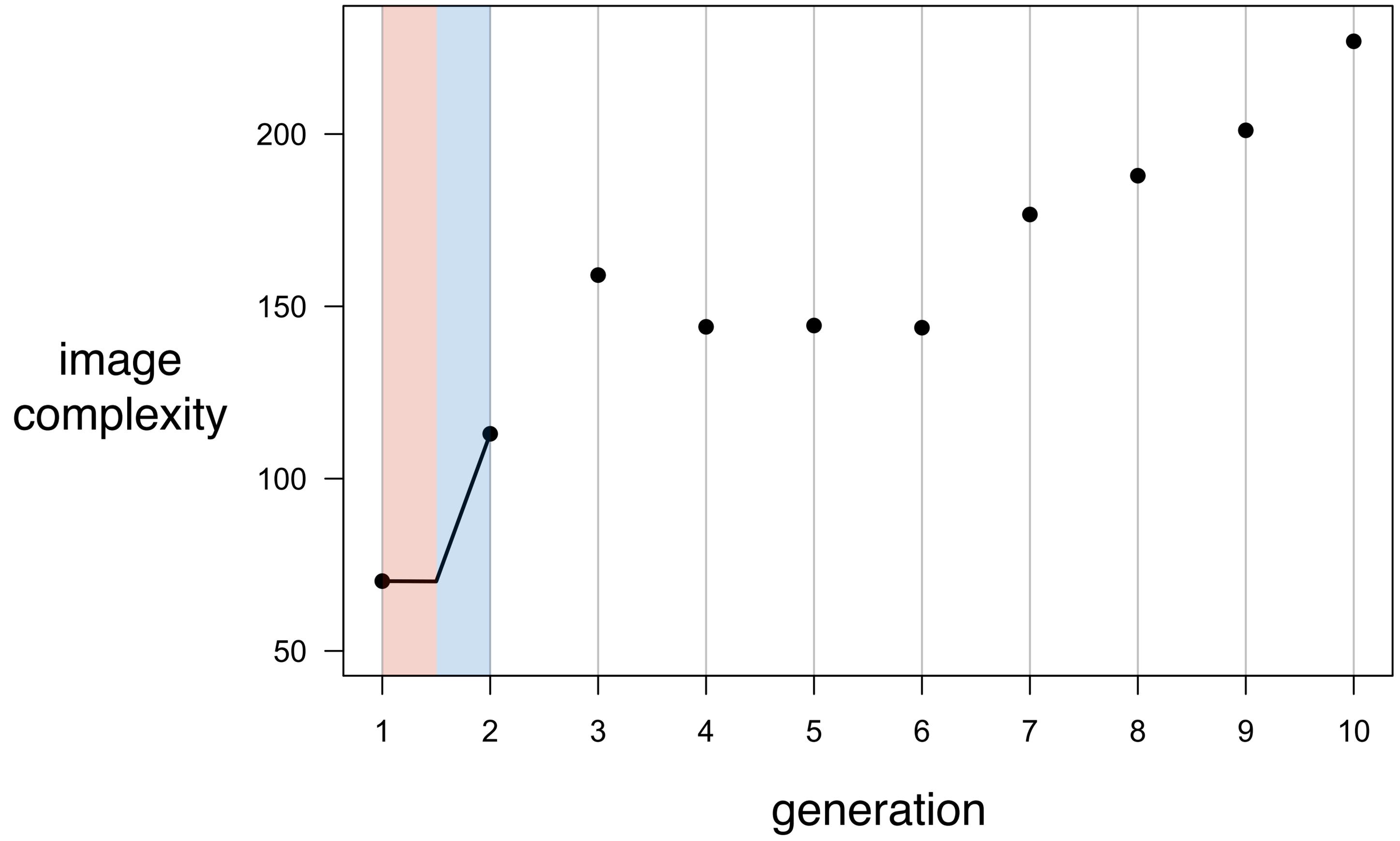
*choose*   *transform*



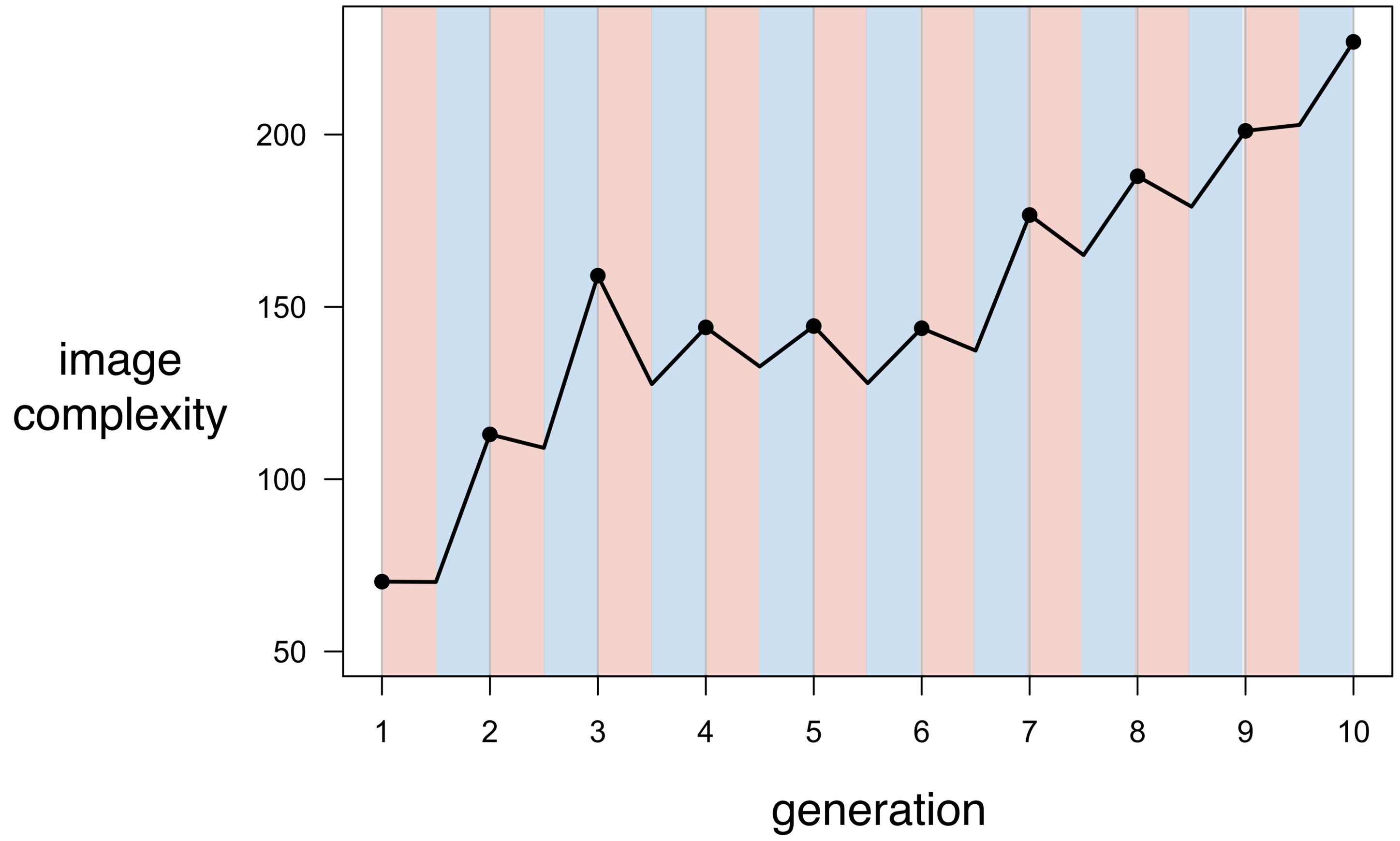
*choose*   *transform*



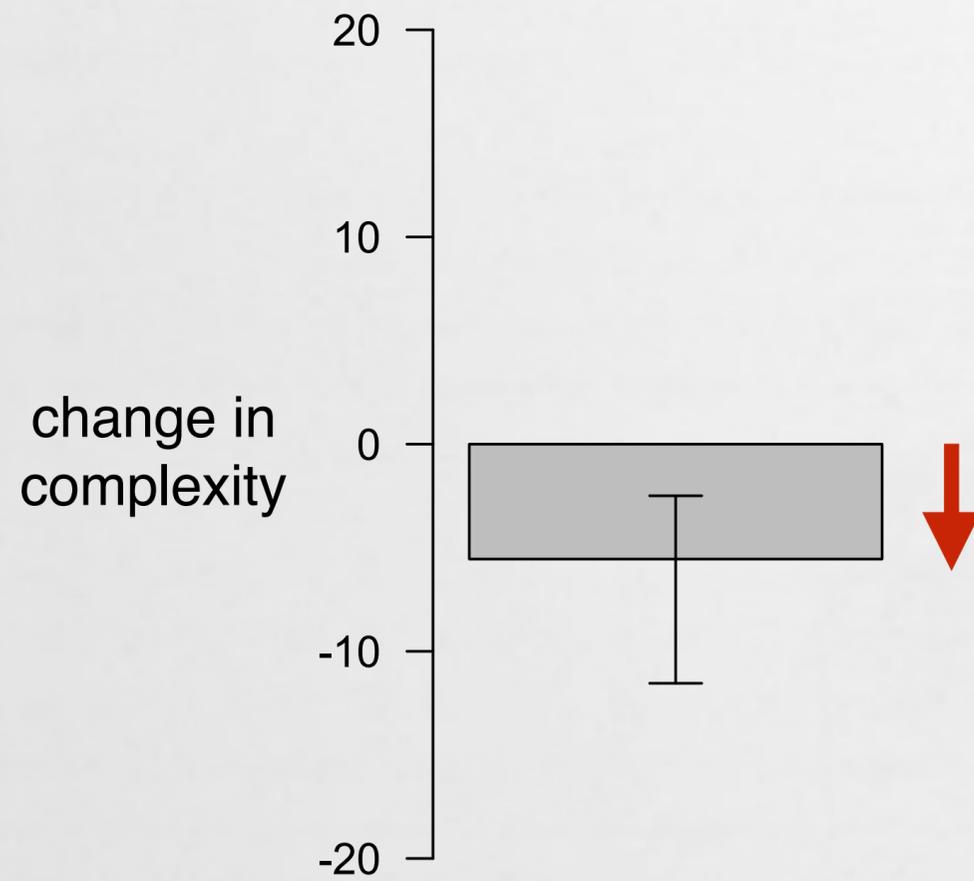
*choose*    *transform*



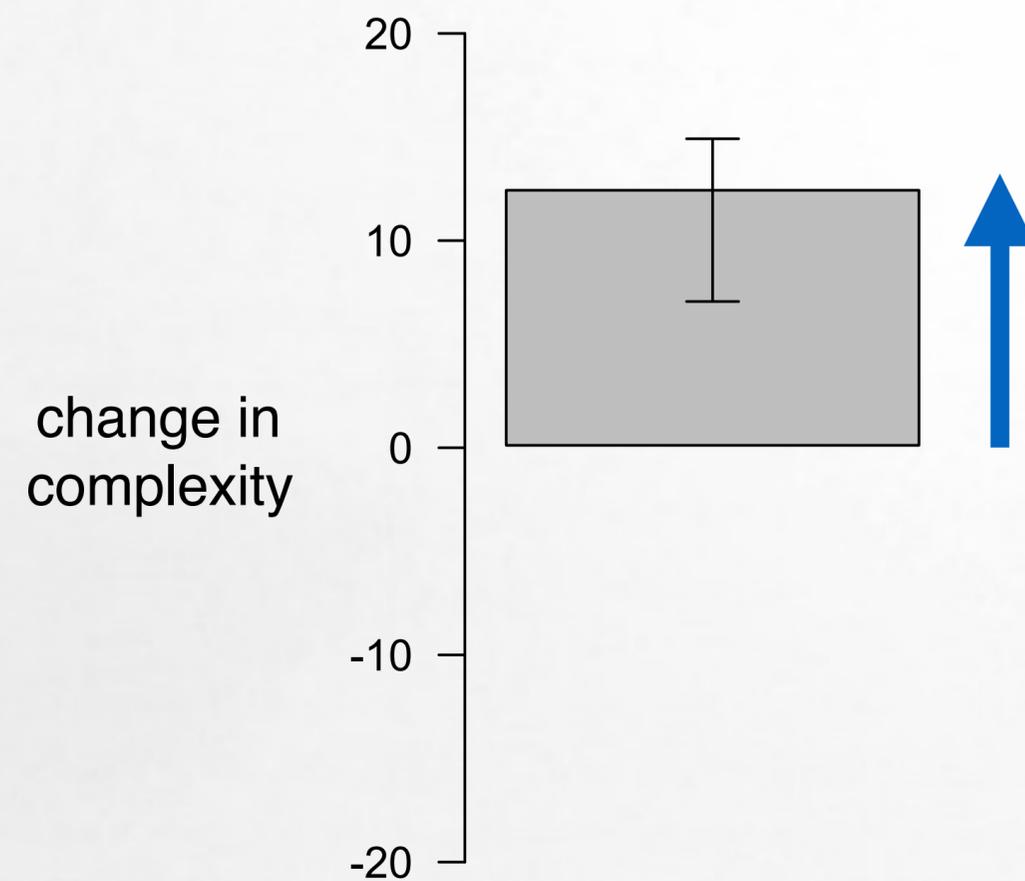
*choose transform*



## choose



## transform



choose

transform

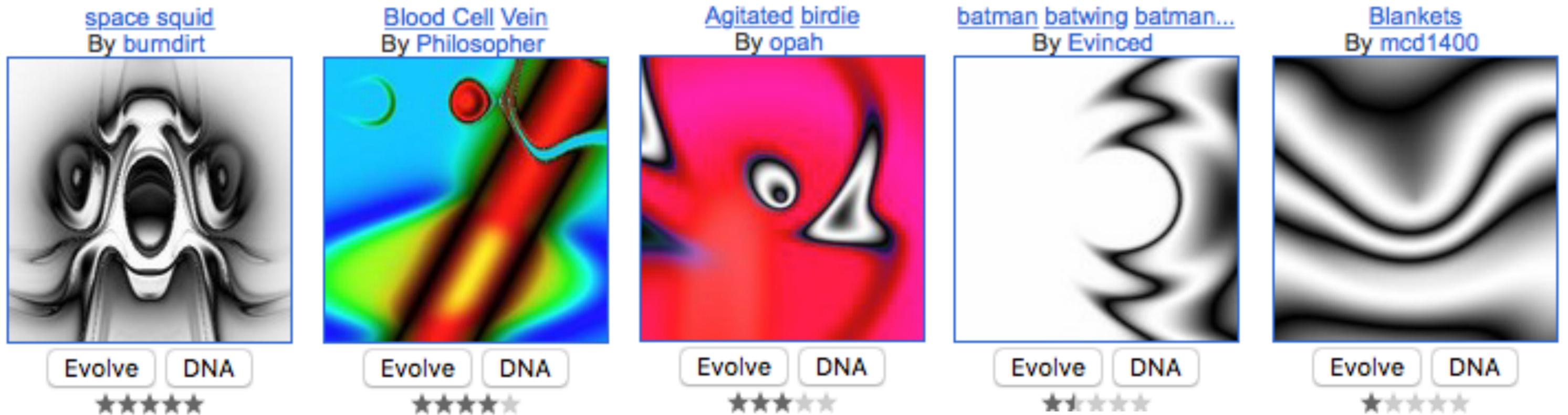
20  
10

**THEY BOTH MATTER**

-20

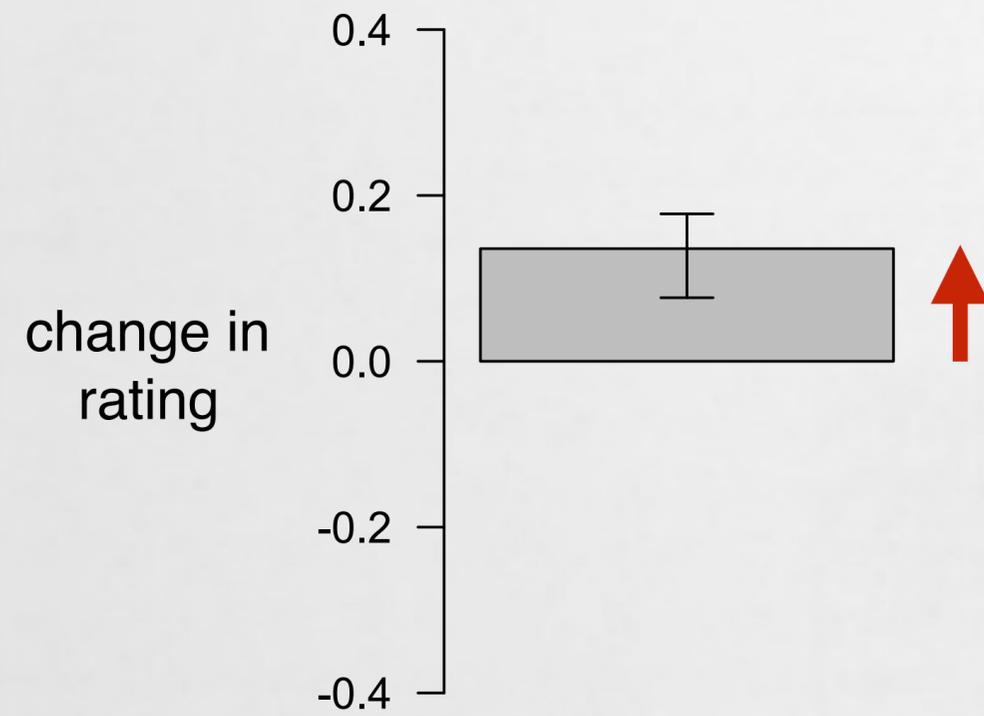
# Community ratings

Now let's repeat the analysis for a different evolving variable

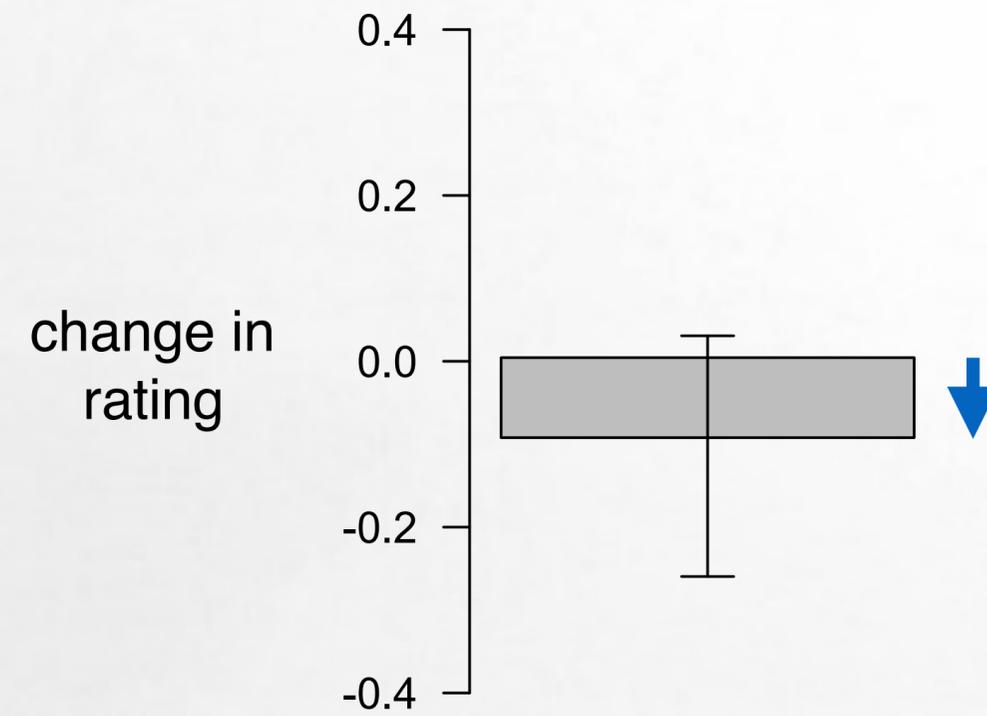


the average rating of the images, among picbreeder members

## choose



## transform





*everyone thinks their baby is the best*

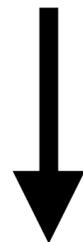
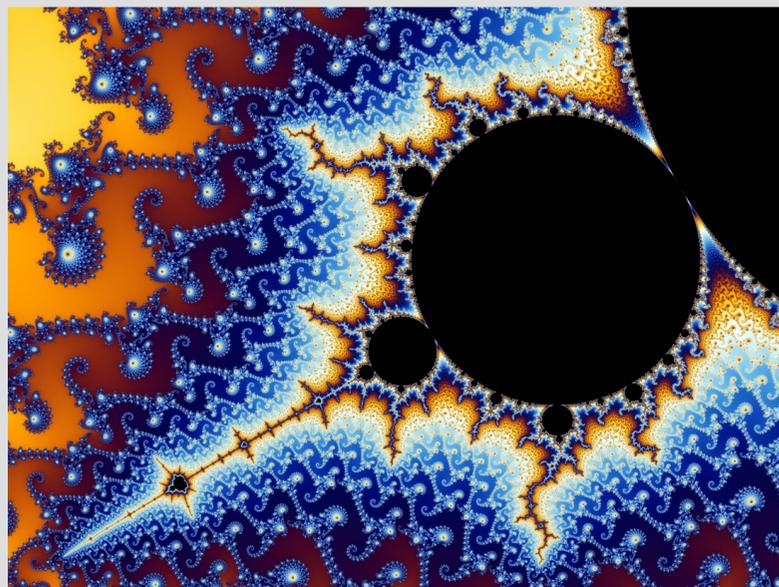


*...but the community's ratings are lower*

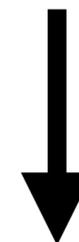
choose

transform

complexity



rating



California school

Paris school



*people choose*

*people transform*